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THE CEPHALOPODS OF THE NORTH-EASTERN COAST OF AMERICA.

PART I.

The Gigantic Squids (Architeuthis) and their Allies; with observations on similar large Species from foreign localities.

By A. E. VERRILL.

[From the Transactions of the Connecticut Academy of Sciences, Vol. V.]

New Haven, Conn., December, 1879–March, 1880.

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The Cephalopods of the North-eastern Coast of America.

By A. E. Verrill.

Part I.—The gigantic squids (*Architeuthis*) and their allies; with observations on similar large species from foreign localities.

The early literature of Natural History has, from very remote times, contained allusions to huge species of Cephalopods, often accompanied by more or less fabulous and usually exaggerated descriptions of the creatures.* In a few instances figures were attempted, which were largely indebted to the imagination of their authors for their more striking peculiarities.

In recent times many more accurate observers have confirmed the existence of such monsters, and several fragments have found their way into European museums.

To Professor Steenstrup and to Dr. Harting, however, belongs the credit of first describing and figuring, in a scientific manner, a sufficient number of specimens to give a fair idea of the real character and affinities of these colossal species. More particular accounts of the specimens described by these and other recent writers will be given farther on.

Special attention has only recently been called to the frequent occurrence of these 'big squids,' as our fishermen call them, in the waters of Newfoundland, and the adjacent coasts. The cod-fishermen, who visit the Grand Banks, appear, from their statements, to have been long familiar with them, and occasionally to have captured and used them for bait. The whalemen have also repeatedly stated that sperm whales feed upon huge squid, and that, when wounded, they

* The description of the "Poulpe" or devil-fish by Victor Hugo, in "The Toilers of the Sea," with which so many readers have recently become familiar, is quite as fabulous and unreal as any of the earlier accounts, and even more bizarre. His description represents no real animal whatever. He has attributed to the creature habits and anatomical structures that belong in part to the *polyps* and in part to the '*poulpe*' (Octopus). His description appears to have been derived from descriptions of these totally distinct groups of animals contained in some cyclopedia, which he has confounded and hopelessly mixed up.

often vomit large fragments of them in such a condition as to be recognizable.* The first reliable account, known to me, of specimens actually taken in American waters by our fishermen and whalemen was published by Dr. A. S. Packard, in 1873.† In that article Dr. Packard described a portion of a jaw from a large specimen (our No. 1) taken by the Gloucester fishermen on the Grand Banks, and a very large pair of jaws taken from the stomach of a sperm whale, (our No. 10). Soon after this, in 1873, a large living specimen was encountered by two fishermen in Conception Bay, and one of the tentacular-arms, which was secured, was preserved in the museum of St. John's, Newfoundland, by the Rev. Mr. Harvey and Mr. Alexander Murray, (our No. 2). Both these gentlemen wrote good and interesting accounts of this specimen, which were extensively copied in the magazines and newspapers, while a photograph of the arm itself was also secured and distributed.

This important addition to our knowledge of these creatures was followed, a few weeks later, by the capture of a nearly perfect specimen of the same species, near St. John's. Mr. Harvey and Mr. Murray likewise secured this specimen and published detailed accounts of it, which gave a more accurate idea of the character of the genus and species than any previous descriptions.

My own attention was specially directed to these large Cephalopods, at that time, on account of being so fortunate as to secure for study most of the preserved portions of all the specimens referred to above, with some additional ones, detailed below. For these very interesting specimens I am especially indebted to the zeal and kindness of the Rev. Mr. Harvey, and to Professor S. F. Baird. To Dr. A. S. Packard I am indebted for the use of the jaws of No. 10. Mr. Pourtales, of the Museum of Comparative Zoology, has also kindly sent the specimens belonging to that museum, and Mr. W. H. Dall has contributed his specimens and drawings of a species from Alaska. Special acknowledgments to others will be found in connection with the descriptions of the specimens.

Although I have, in several former papers,‡ given details of the

* See Maury's Sailing Directions; also articles by N. S Shaler, American Naturalist. vol. vii, p. 3, 1873; by Dr. Packard, op. cit., p. 90; and by Mr. W. H. Dall, op. cit., p. 484.

† American Naturalist, vol. vii, p. 91, February, 1873.

‡ American Jour. Science, vol. vii, p. 158, Feb., 1874; vol. ix, pp. 123, 177, Plates II–V, 1875; vol. x, p. 213, Sept., 1875; vol. xii, p. 236, 1876; vol. xiv, p. 425, Nov., 1877. American Naturalist, vol. viii, p. 167, 1874; vol. ix, pp. 21, 78, Jan. and Feb., 1875.

time and place of occurrence of fourteen of the specimens enumerated below, it seems desirable to bring together, at this time, accounts of all these, as well as of several additional specimens, in order that the various descriptions and measurements may be more readily compared, and also that some errors in the former accounts may be corrected and new information added. To facilitate the comparison of the general accounts of the twenty examples that I am now able to enumerate from our coast, I have given, by themselves, the statements of the time and place of their occurrence, with such general descriptions and measurements of each, as are most available, reserving the more detailed special descriptions of the preserved specimens for the systematic part of this article.

This seemed the more desirable because the information concerning many of the specimens is so scanty as to render it impossible to refer them, with certainty, to either of the species now recognized or named. It is probable, however, that only three distinct forms exist among the large Newfoundland specimens of *Architeuthis*, and two of these may be merely the males and females of one species. One of the principal differences usually indicated by the measurements is in respect to the size and length of the shorter arms, one form having them comparatively stout, often "thicker than a man's thigh," while the other form has them long and slender, (usually three to five inches in diameter, with a length of six to eleven feet). In case these differences prove to be sexual, those with stout arms will probably be the females, judging from analogy with the small squids nearest related.* The two specimens, of which I have seen the arms, both have them long and slender, but in one the arms are much longer in proportion to the body than in the other, and there are marked differences in the denticulation of the suckers of the short arms. These differences appear to indicate two species.

A few words of explanation may be desirable in regard to the relative value of the measurements usually given, and also with reference

* By examinations of very numerous specimens of the common squids, *Ommastrephes illecebrosa* and *Loligo Pealii*, I have satisfied myself that the females of both differ from the males by having the head, the siphon, the arms, and the suckers relatively larger and stronger than in the males. In comparing specimens of the two sexes having the body and fins of the same length, this difference is very evident. The large suckers of the tentacular arms show this increased size in a very marked degree. The short arms show a greater increase in diameter than in length. In my former article, by an unfortunate error, the increase in size of these parts was inadvertently said to be in the male. In these common squids I have found scarcely any variation in the relative size and form of the caudal fins, when adult.

to the parts most useful to preserve when, as will usually happen, the whole cannot be saved. The measurements of the soft external parts of Cephalopods are, for the most part, only approximate, and they are not all of equal value, for some parts are more changeable in size and shape than others. The long, contractile tentacular-arms, especially, are liable to great variation in length according to their state of contraction or extension, and therefore their relative length is of little or no value in discriminating species. Unfortunately this, either by itself or combined with the length of the 'body' as total length, is often the principal one given. The circumference of the body varies, likewise, according to its state of contraction or relaxation, and the 'breadth' of the body, when such soft creatures are stranded on the shore, will depend much upon the extent to which it is collapsed and flattened from its proper cylindrical form, and is of less value than the circumference. Measurements of the length of the body to the mantle edge, and to the base of the arms; length and circumference of the various pairs of short arms; of the length and circumference of the head; size of the eyes; length and breadth of the tail-fin; size of the largest suckers on the different arms; and size of the 'club' of the long arms, are all very useful and valuable. The shape of the tail-fin should be carefully noted, also the presence or absence of eye-lids, and of a sinus or groove at the front edge of eye-lids. The size and shape of the thin internal 'bone' or 'pen' is particularly desirable. Usually it will not be possible to preserve the pen in any satisfactory shape by drying, for it cracks in pieces and curls up. It may be preserved packed in salt, in brine, or in alcohol. The same is true of the beak. The horny rims of the suckers can usually be dried, but are better by far in alcohol or brine. The parts most useful for preservation in alcohol or salt, in cases when only a portion can be saved, are the long tentacular-arms, especially their terminal 'clubs' with the suckers in place; the short arms, with their suckers; of these the left arm of the lower, or ventral, pair will probably be the most valuable, being probably the one that will show the sexual distinction, by the alteration of its suckers toward the tip or in some other part; the lateral arms next to the ventral are next in importance; the caudal fin, and if possible the entire head, should be preserved; also the 'pen,' if possible. In cases where the head cannot be saved entire, even with the arms removed, the beak and tongue, and other fleshy parts in and behind the beak, should be carefully preserved, as nearly entire as possible, either in strong brine or alcohol.

General account of the several specimens, and of their occurrence.

No. 1.—Grand Banks specimen, 1871. (*Architeuthis princeps.*)

PLATE XVIII, FIGURE 3.

This specimen was found floating at the surface, on the Grand Banks of Newfoundland, in October, 1871, by Captain Campbell, of the schooner "B. D. Haskins," of Gloucester, Mass. It was taken on board and part of it used for bait.* Dr. A. S. Packard has given, in the American Naturalist, vol. vii, p. 91, Feb., 1873, the facts that have been published in regard to the history of this individual. But its jaws were sent to the Smithsonian Institution, and were sent to me by Professor Baird to be described and figured. The horny jaw or beak from this specimen is thick and strong, nearly black; it is acute at the apex, with a decided notch or angle on the inside, about ·75 of an inch from the point, and beyond the notch is a large prominent angular lobe. The body of the specimen from which this jaw was taken is stated to have measured 15 feet in length and 4 feet 8 inches in circumference. The arms were mutilated, but the portions remaining were estimated to be 9 or 10 feet long, and 22 inches in circumference, two being shorter than the rest. It was estimated to weigh 2000 pounds.

No. 2.—Conception Bay specimen, 1873. (*A. Harveyi ?.*)

A large individual attacked two men, who were in a small boat, in Conception Bay, October 27, 1873. Two of the arms, which it threw across the boat, were cut off with a hatchet, and brought ashore. Full accounts of this adventure, written by Rev. M. Harvey, have been published in many of the magazines and newspapers.† A portion of one of these arms, measuring 19 feet in length, was preserved by Rev. M. Harvey and Mr. Alexander Murray for the museum at

* I have been informed by many other fishermen that these 'big squids,' as they call them, are occasionally taken on the Grand Banks and used for bait. Others state that they have seen them in that region, without being able to capture them. Nearly all the specimens hitherto taken appear to have been more or less disabled when first observed, otherwise they probably would not appear at the surface in the day-time. From the fact that they have mostly come ashore in the night, I infer that they inhabit chiefly the very deep and cold fiords of Newfoundland and come up to the surface only in the night.

† See Amer. Jour. Science, vol. vii, p. 158, 1874; and American Naturalist, vol. viii, No. 2. p. 120. Feb., 1874, in a letter from Mr. Alexander Murray. Also, Proc. Zool. Soc. Lond., p. 178, 1874. Proc. Boston Soc. Nat. Hist., xvi, p. 161, 1873.

St. John's, Newfoundland. It was photographed, and cuts copied from the photograph were published in some of the English magazines.* Before it was secured for preservation it had been considerably injured, many of the larger suckers having been torn off or mutilated. Owing to this fact they were originally described by Mr. Harvey as destitute of marginal denticulations, but he subsequently reëxamined the specimen, at my request, and informed me that they were all originally denticulated. Of this specimen I have seen only the photograph and some of the smaller suckers. This fragment represents the distal half of one of the long tentacular-arms, with its expanded terminal portion or "club," originally covered with cup-shaped suckers, about 24 of which, forming two central rows, are very large, the largest being 1·25 inches in diameter; others, alternating with these along each margin, are smaller, with the edge supported by a serrated ring. The tip of the arm is covered with numerous smaller suckers, in four rows. The part of the arm preserved measured, when fresh, 19 feet in length, and 3·5 inches in circumference, but wider, "like an oar," and 6 inches in circumference, near the end, where the suckers are situated.

It is stated that six feet of this arm had been destroyed before it was preserved, and the captors estimated that they left from six to ten feet attached to the creature, which would make the total length between 31 and 35 feet. According to Mr. Murray, the portion preserved measured but 17 feet in length, when he examined it, Oct. 31, 1873, after it had been a few days in strong brine. The other arm was destroyed and no description was made; but the portion secured was estimated by the fishermen to have been 6 feet long and 10 inches in diameter; it was evidently one of the eight shorter sessile arms, and its size was probably overestimated. The fishermen estimated the body of this individual to have been about 60 feet in length and 5 feet in diameter; but if the proportions be about the same as in the specimens since captured, (No. 5 and No. 14), as I believe, then the body could not have been more than about 10 feet long, and 2·5 feet in diameter, and the long arms should have been about 32 feet in length.† Allowing two feet for the head, the total length would, therefore, be about 44 feet.

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* See Annals and Magazine of Natural History, IV. xiii, p. 68, Jan., 1874; and "The Field." Dec. 13, 1873. The central line of this photograph is reduced four and a quarter times, while the front part is reduced about four times.

† Doubtless these long arms are very contractile, and changeable in length, like those of the ordinary squids.

No. 3.—Coombs' Cove specimen, 1872. (*A. Harveyi?*, ♀.)

Another specimen (No. 3), probably considerably larger than the last, was captured at Coombs' Cove, Fortune Bay, Newfoundland. The following account has been taken from a newspaper article of which I do not know the precise date,* forwarded to me by Professor Baird, together with a letter, dated June 15, 1873, from the Hon. T. R. Bennett, of English Harbor, N. F., who states that he wrote the article, and that the measurements were made by him, and are perfectly reliable.†

"Three days ago, there was quite a large squid run almost ashore at Coombs' Cove, and some of the inhabitants secured it. The body measured 10 feet in length and was nearly as large round as a hogshead. One arm was about the size of a man's wrist, and measured 42 feet in length; the other arms were only 6 feet in length, but about 9 inches in diameter, very stout and strong. The skin and flesh were 2·25 inches thick, and reddish inside as well as out. The suction cups were all clustered together, near the extremity of the long arm, and each cup was surrounded by a serrated edge, almost like the teeth of a hand-saw. I presume it made use of this arm for a cable, and the cups for anchors, when it wanted to come to, as well as to secure its prey, for this individual, finding a heavy sea was driving it ashore, tail first, seized hold of a rock and moored itself quite safely until the men pulled it on shore."

Mr. Bennett, in a memorandum subsequently given to Mr. Sanderson Smith, and communicated to me by him, states that both the tentacular-arms were present and that the shorter one was 41·5 feet in length. The large diameter of the short arms, compared with their length, and with that of the long arms, and their shortness compared with the length of the body, are points in which this specimen apparently differed essentially from those that have been preserved and are better known. It was probably a female. The total length, as I understand the measurements, was 52 feet.

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* The exact date of this capture I do not know, but it was probably in the autumn or winter of 1872.

† Through Mr. Sanderson Smith, who visited Mr. Bennett after the publication of my former articles, I learn that this specimen is the same as the one designated as No. 6 in my previous papers, and that the measurements of No. 6, as given to me by Mr. Harvey, are incorrect, owing to a mistake in supposing that 42 feet was the *total length*, instead of the length of the longer tentacular-arm.

No. 4.—Bonavista Bay specimen. (*A. Harveyi* ?.)

PLATE XVI, FIGURES 5, 6.

A pair of jaws and two of the suckers from the tentacular-arms were forwarded to me by Professor Baird of the Smithsonian Institution. These were received from Rev. A. Munn, who writes that they were taken from a specimen that came ashore at Bonavista Bay, Newfoundland; that it measured thirty-two feet in length (probably the entire length, including the tentacular-arms); and about six feet in circumference. The jaws are large and broad, resembling those of No. 5, both in size and form, but much thinner than those of No. 1, and without the deep notch and angular lobe seen in that specimen. The suckers also agree with those of No. 5, but are a little smaller.

No. 5.—Logie Bay specimen, 1873. (*Architeuthis Harveyi*, type.)

PLATE XIII. PLATE XIV. PLATE XV, FIGURES 1, 2, 3. PLATE XVI, FIGURES 1 TO 4.

A complete specimen was captured in November, 1873, at Logie Bay, near St. John's, Newfoundland. It became entangled in herring-nets and was secured by the fishermen with some difficulty, and only after quite a struggle, during which its head was badly mutilated and severed from the body, and the eyes, most of the siphon-tube, and part of the front edge of the mantle were destroyed. It is probable that this was a smaller specimen of the same species as No. 2. Fortunately this specimen was secured by the Rev. M. Harvey of St. John's. After it had been photographed and measured, he attempted to preserve it entire in brine, but this was found to be ineffectual, and after decomposition had begun to destroy some of the most perishable parts, he took it from the brine and, dividing it into several portions, preserved such parts as were still undecomposed in strong alcohol. These various portions have all been examined by me and part of them are now in my possession, and with the photographs have enabled me to present a restoration, believed to be tolerably accurate, of the entire creature (plate XIV). In this figure the eyes, ears, siphon-tube and front edge of the mantle have been restored from a small squid (*Ommastrephes*). The other parts have been drawn directly from the photographs and specimens.* There were two photographs of the

* The figure was originally made, from the photographs only, by Mr. P. Rœtter, of the Museum of Comparative Zoology, but after the arrival of the specimens it had to be altered in many parts. These necessary changes were made by the writer, after a careful study of the parts preserved, in comparison with the photographs and original measurements. As published in my former papers, the eyes and back of the head of

specimen:* one showing the entire body, somewhat mutilated anteriorly; the other showing the head with the ten arms attached (plate XIII). The body or mantle of this specimen was about seven feet long, and between five and six feet in circumference; the relatively small caudal fin was arrow-shaped and twenty-two inches broad, but short, thick, and very pointed at the end; the two long tentacular-arms were twenty-four feet in length, and two and a half inches in circumference, except at the broader part near the end; the largest suckers, which form two regular alternating rows, of twelve each, were 1·25 inches in diameter, with serrated edges. There is also an outer row of much smaller suckers, alternating with the large ones, on each margin; the terminal part is thickly covered with small serrated suckers; and numerous small suckers and tubercles are crowded on that portion of the arms where the enlargement begins, before the commencement of the rows of large suckers. The arrangement of the suckers is nearly the same as on the long arm of No. 2, but in the latter the terminal portion of the arm, beyond the large suckers, as shown in the photographs, is not so long, tapering, and acute, but this may be due to the different conditions of the two specimens. The eight short arms were each six feet long; the two largest were ten inches in circumference at base; the others were 9, 8 and 7 inches. These short arms taper to slender acute tips, and each bears about 100 large, oblique suckers, with serrated margins.

The portions of the pen in my possession belong mostly to the two ends, with fragments from the middle region, so that although neither the actual length nor the greatest breadth can be given, we can yet judge very well what its general form and character must have been. It was a broad and thin structure, of a yellowish brown color, and translucent. Its anterior portion (plate XV, fig. 3) resembles that of *Loligo*, but its posterior termination is entirely different, for instead of having a regular lanceolate form, tapering to a point at

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the figure were restored as in *Loligo*. Subsequent studies and additional specimens show that this genus is closely allied to *Ommastrephes*. Therefore, the head would have been more correctly shown had it been restored with reference to that genus, which has been done in this paper. The most obvious difference is in the eyes, which have distinct lids and an anterior sinus.

* Cuts made from these photographs have been published in several magazines and newspapers, but they have been engraved with too little attention to details to be of much use in the discrimination of specific differences. I have, therefore, prepared new figures from these photographs with the greatest care possible. These figures are particularly valuable, as showing the arrangements of the suckers on the short arms.

the posterior end, as in *Loligo*, it expands and thins out toward the posterior end, which is very broadly rounded or irregularly truncate, fading out insensibly, both at the edges and end, into soft membrane. The anterior end, for about an inch and a half, was rapidly narrowed to a pen-like point, as in *Loligo;* from this portion backward the width gradually increases from 1·2 inches to 5 inches, at a point 25 inches from the end, where our specimen is broken off; at this place the marginal strips are wanting, but the width is 5 inches between the lateral midribs (*d*, *d''*), which were, perhaps, half an inch from the margin. Along the center of the shell, there is a strong, raised, rounded midrib, which fades out a short distance from the posterior end, but is very conspicuous in the middle and anterior sections. On each side of the midrib is a lateral rib of smaller size. These at first diverge rapidly from the central one, and then run along nearly parallel with the outer margin and about ·4 of an inch from it, but beyond 11 inches from the point the margins are torn off. Like the midrib the lateral ribs gradually fade out before reaching the posterior end; near the place where they finally disappear, they are about six inches apart.*

No. 6 (of former articles).—Same as No. 3.

No. 7.—Labrador specimen.

Dr. D. Honeyman, geologist, of Halifax, Nova Scotia, has published, in a Halifax paper, a statement made to him by a gentleman who claims to have been present at the capture of another specimen (No. 7) in the Straits of Belle Isle, at West St. Modent, on the Labrador side. "It was lying peacefully in the water when it was provoked by the push of an oar. It looked fierce and ejected much water from its funnel; it did not seem to consider it necessary to discharge its sepia, as mollusca of this kind generally do, in order to cover their escape." . . . . "The length of its longest arm was 37 feet; the length of the body 15 feet; whole length 52. The bill was very

* Mr. Harvey published popular accounts of this specimen and of the previously captured arm of the larger one (No. 2), in the Maritime Monthly Magazine of St. John, N. B., for March, 1874, and in several newspapers. Acknowledgments are also due to Mr. Alexander Murray, Provincial Geologist, who coöperated with Mr. Harvey in the examination and preservation of these specimens, and who has also written some of the accounts of them that have been published. See also the American Naturalist, vol. viii, p. 122, February, 1874; American Journal of Science, vol. vii, p. 460; Nature, vol. ix, p. 322, February 26, 1874; and Appleton's Journal, January 31, 1874; Forest and Stream, p. 356 (with figure), Jan., 1874.

large. The suckers of its arms or feet, by which it lays hold, about 2 inches in diameter. The monster was cut up, salted, and barreled for dog's meat." In this account the length given for the 'body' evidently includes the head also. This creature was probably disabled, and perhaps nearly dead, when discovered at the surface, and this seems to have been the case with most of the specimens hitherto seen living. Animals of this sort probably never float or lie quietly at the surface when in good health.

Nos. 8 and 9.—Lamaline specimens, 1870-71.

Mr. Harvey refers to a statement made to him by a clergyman, Rev. M. Gabriel, that two specimens (Nos. 8 and 9), measuring respectively 40 and 45 feet in total length, were cast ashore at Lamaline, on the southern coast of Newfoundland, in the winter of 1870–71.

No. 10.—Sperm Whale specimen. (*Architeuthis princeps.*)

PLATE XVIII, FIGURES 1, 2.

This specimen, consisting of both jaws, was presented to the Peabody Academy of Science, at Salem, Mass., by Captain N. E. Atwood, of Provincetown, Mass. It was taken from the stomach of a sperm whale, but the precise date and locality are not known. It was probably from the North Atlantic. The upper jaw was imperfectly figured by Dr. Packard in his article on this subject.* It is one of the largest jaws yet known, and belonged to an apparently undescribed species, which I named *Architeuthis princeps*, and described in my former papers, with figures of both jaws.

No. 11.—Second Bonavista Bay specimen, 1872.

The Rev. M. Harvey, in a letter to me, stated that a specimen was cast ashore at Bonavista Bay, December, 1872, and that his informant told him that the long arms measured 32 feet in length, and the short arms about 10 feet in length, and were "thicker than a man's thigh." The body was not measured, but he thinks it was about 14 feet long, and very stout, and that the largest suckers were 2·5 inches in diameter. The size of the suckers is probably exaggerated, and most likely the length of the body also. It is even possible that this was the same specimen from which the beak and suckers described as No. 4, from Bonavista Bay, were derived, for the date of capture of that specimen is unknown to me. The latter, however, was much smaller than the

* American Naturalist, vol. vii, p. 91, 1873.

above measurements, and it will, therefore, be desirable to give a special number (11) to the present one.

No. 12.—Harbor Grace specimen, 1874-75.

Another specimen, which we have designated as No. 12, was cast ashore in the winter of 1874–1875, near Harbor Grace, but was destroyed before its value became known, and no measurements were given.

No. 13.—Fortune Bay specimen, 1874.

PLATE XVII.

A specimen was cast ashore December, 1874, at Grand Bank, Fortune Bay, Newfoundland. As in the case of several of the previous specimens, I was indebted to the Rev. M. Harvey for early information concerning this one, and also for the jaws and one of the large suckers of the tentacular-arms, obtained through Mr. Simms, these being the only parts preserved. Although this specimen went ashore in December, Mr. Harvey did not hear of the event until March, owing to the unusual interruption of travel by the severity of the winter. He informed me that Mr. George Simms, Magistrate of Grand Bank, had stated in a letter to him that he examined the creature a few hours after it went ashore, but not before it had been mutilated by the removal of the tail by the fishermen, who finally cut it up as food for their numerous dogs; and that the long tentacular arms were 26 feet long and 16 inches in circumference; the short arms were about one-third as long as the long ones; the "back of the head or neck was 36 inches in circumference," (evidently meaning the head, behind the bases of the arms); the length of the body "from the junction to the tail" was 10 feet, (apparently meaning from the base of the arms to the origin of the caudal fins). He thought that the tail, which had been removed, was about one-third as long as the body, but this was probably overestimated. In No. 14 the tail, from its origin or base, was about one-fifth as long as the balance of the body and head. Applying the same proportions to No. 13, the head and body together would have been 12 feet. In a letter to me, dated Oct. 27, 1875, Mr. Simms confirmed the above measurements, but stated that the long arms had been detached, and that the bases of the arms measured as those of the tentacular-arms (they had previously been cut off about a foot from the head), were triangular in outline, the sides being respectively 5, 6, 5 inches in breadth, the longest or outer side being convex and the two lateral sides straight.

He moreover says that *all* the arms were covered with large suckers, *from the base outward.* Hence it is probable that he made a mistake as to these stumps, and that they really belonged to a pair of sessile arms. Probably the tentacular-arms, when extended, had been cut off so close to their contractile bases that their stumps had afterwards become contracted within their basal pouches, and were, therefore, overlooked. He adds that the body was three feet broad (doubtless it was much flattened from its natural form), and that the measurements were made while the body lay upon uneven ground, so that its exact length could not be easily ascertained, and that the caudal-fin had been cut off at its base. As the tail-fins of Nos. 5 and 14 were about one-fifth the length of the rest of the body and the head together, this specimen, if belonging to either of those species, should have been about 12 feet from the base of the arms to the tip of the tail.

The large sucker, in my possession, is one inch in diameter, across the denticulated rim, and in form and structure agrees closely with those described and figured by me from the tentacular-arms of Nos. 4, 5 and 14, (Plate XVI, figs. 3, 5, 6, and Plate XVII, figures 1, 1ª).

The jaws are still attached together, in their natural position, by the cartilages. They agree very closely in form with the large jaws of *Architeuthis princeps* V. (No. 10), figured on Plate XVIII, but they are about one-tenth smaller.

No. 14.—Catalina specimen, 1877. (*Architeuthis princeps.*)

PLATE XVII, FIGS. 1–5. PLATE XIX. PLATE XX.

A nearly perfect specimen of a large squid, was found cast ashore after a severe gale, at Catalina, Trinity Bay, Newfoundland, Sept. 24, 1877. It was living when found. It was exhibited for two or three days at St. John's, and subsequently was carried in brine to New York, where it was purchased by Reiche & Brother for the New York Aquarium. There I had an opportunity to examine it, very soon after its arrival.* I am also indebted to the proprietors of the aquarium for some of the loose suckers. Other suckers from this specimen were sent to me from Newfoundland, by the Rev. M. Harvey. Although

* See American Journal of Science and Arts, vol. xiv, p. 425, Nov., 1877. When examined by me it was loose in a tank of alcohol. Dr. J. B. Holder gave me valuable assistance in making this examination, and also made one of the drawings of the caudal fin. It was afterwards "prepared" for exhibition by a taxidermist, who misplaced the arms, siphon, and other parts, and inserted two large, round, flat, red eyes close together on the top of the head!

somewhat mutilated, and not in a very good state of preservation when received, it is of great interest, being, without doubt, the largest and best specimen ever preserved. The Catalina specimen, when fresh,* was 9·5 feet from tip of tail to base of arms; circumference of body, 7 feet; circumference of head, 4 feet; length of tentacular-arms, 30 feet; length of longest sessile arms (ventral ones), 11 feet; circumference at base, 17 inches; circumference of tentacular arms, 5 inches; at their expanded portion, 8 inches. Length of upper mandible, 5·25 inches; diameter of large suckers, 1 inch; diameter of eye-openings, 8 inches. The eyes were destroyed by the captors. It agrees in general appearance with *A. Harveyi* (No. 5), but the caudal fin is broader and somewhat less acutely pointed than in that species, as seen in No. 5; it was two feet and nine inches broad, when fresh, and broadly sagittate in form. The dried rims of the large suckers are white, with very acutely serrate margins; the small smooth-rimmed suckers, with their accompanying tubercles, are distantly scattered along most of the inner face of the tentacular arms, the last ones noticed being nineteen feet from the tips. The sessile arms present considerable disparity in length and size, the ventral ones being somewhat larger and longer than the others, which were, however, more or less mutilated when examined by me; the serrations are smaller on the inner edge than on the outer edge of the suckers. On the smaller suckers the inner edge is often without serrations.

No. 15.—Hammer Cove specimen, 1876.

In a letter from Rev. M. Harvey, dated Aug. 25, 1877, he states that a big squid was cast ashore Nov. 20, 1876, at Hammer Cove, on the southwest arm of Green Bay, in Notre Dame Bay, Newfoundland. When first discovered by his informant it had already been partially devoured by foxes and sea-birds. Of the body, a portion 5 feet long remained, with about 2 feet of the basal part of the arms. The head was 18 inches broad; tail, 18 inches broad; eye-sockets, 7 by 9 inches; stump of one of the arms, 2·5 inches in diameter.

The only portion secured was a piece of the 'pen' about 16 inches long, which was given to Mr. Harvey.

No. 16.—Lance Cove specimen, 1877. (*Architeuthis princeps* ?, ♀.)

In a letter dated Nov. 27, 1877, Mr. Harvey gives an account of another specimen which was stranded on the shore at Lance Cove,

* Measurements of the freshly caught specimen were made by the Rev. M. Harvey, at St. John's, and communicated to me.

Smith's Sound, Trinity Bay, about twenty miles farther up the bay than the locality of the Catalina Bay specimen (No. 14). He received his information from Mr. John Duffet, a resident of the locality, who was one of the persons who found it and measured it. His account is as follows: "On Nov. 21, 1877, early in the morning, a 'big squid' was seen on the beach, at Lance Cove, still alive and struggling desperately to escape. It had been borne in by a 'spring tide' and a high inshore wind. In its struggles to get off it ploughed up a trench or furrow about thirty feet long and of considerable depth by the stream of water that it ejected with great force from its siphon. When the tide receded it died. Mr. Duffet measured it carefully, and found that the body was nearly 11 feet long (probably including the head); the tentacular-arms, 33 feet long. He did not measure the short arms, but estimated them at 13 feet, and that they were much thicker than a man's thigh at their bases. The people cut the body open and it was left on the beach. It is an out-of-the-way place, and no one knew that it was of any value. Otherwise it could easily have been brought to St. John's, with only the eyes destroyed and the body opened." It was subsequently carried off by the tide, and no portion was secured.

This was considerably larger than the Catalina specimen.

The great thickness of the short arms of this specimen, and of some of the others, indicates a species distinct from *A. Harveyi*, unless the sexes of that species differ more than is usual in this respect, among the smaller squids. The length of the sessile arms, if correctly stated, would indicate that this specimen belonged to *A. princeps*. In the female *Ommastrephes illecebrosa*, the common northern squid, the head is larger and the short arms are stouter and have larger suckers than in the male, of the same length.

No. 17.—Trinity Bay specimen, 1877.

Mr. Harvey also states that he had been informed by Mr. Duffet that another very large 'big squid' was cast ashore in October, 1877, about five miles farther up Trinity Bay than the last. It was cut up and used for manure. No portions are known to have been preserved, and no measurements were given.

No. 18.—Thimble Tickle specimen, 1878.

The capture of this specimen has been graphically described by Mr. Harvey, in a letter to the Boston Traveller, of Jan. 30, 1879.

"On the 2d day of November last, Stephen Sherring, a fisherman

residing in Thimble Tickle, not far from the locality where the other devil-fish [No. 19], was cast ashore, was out in a boat with two other men; not far from the shore they observed some bulky object, and, supposing it might be part of a wreck, they rowed toward it, and, to their horror, found themselves close to a huge fish, having large glassy eyes, which was making desperate efforts to escape, and churning the water into foam by the motion of its immense arms and tail. It was aground and the tide was ebbing. From the funnel at the back of its head it was ejecting large volumes of water, this being its method of moving backward, the force of the stream, by the reaction of the surrounding medium, driving it in the required direction. At times the water from the siphon was black as ink."

"Finding the monster partially disabled, the fishermen plucked up courage and ventured near enough to throw the grapnel of their boat, the sharp flukes of which, having barbed points, sunk into the soft body. To the grapnel they had attached a stout rope which they had carried ashore and tied to a tree, so as to prevent the fish from going out with the tide. It was a happy thought, for the devil-fish found himself effectually moored to the shore. His struggles were terrific as he flung his ten arms about in dying agony. The fishermen took care to keep a respectful distance from the long tentacles, which ever and anon darted out like great tongues from the central mass. At length it became exhausted, and as the water receded it expired.

"The fishermen, alas! knowing no better, proceeded to convert it into dog's meat. It was a splendid specimen—the largest yet taken—the body measuring 20 feet from the beak to the extremity of the tail. It was thus exactly double the size of the New York specimen, and five feet longer than the one taken by Budgell. The circumference of the body is not stated, but one of the arms measured 35 feet. This must have been a tentacle."

No. 19.—Three Arms specimen, 1878. (*Architeuthis princeps ?.*)

Mr. Harvey has also given an account of this specimen, in the same letter to the Boston Traveller, referred to under No. 18. This one was found cast ashore after a heavy gale of wind, Dec. 2, 1878, by Mr. William Budgell, a fisherman residing at a place called Three Arms. It was dead when found, and was cut up and used for dog meat. Mr. Harvey's account is as follows:

"My informant, a very intelligent person, who was on a visit in that quarter on business, arrived at Budgell's house soon after he

had brought it home in a mutilated state, and carefully measured some portions with his own hand. He found that the body measured 15 feet from the beak to the end of the tail, which is five feet longer than the New York specimen. The circumference of the body at its thickest part was 12 feet. He found only one of the short arms perfect, which was 16 feet in length, being five feet longer than a similar arm of the New York specimen, and he describes it as "thicker than a man's thigh." The statement that the sessile arms were longer than the head and body together, indicates that this was a specimen of *A. princeps*, like No. 14, but larger.

No. 20.—Banquereau specimen, 1878. (*Architeuthis megaptera* V.?)

This consists of the terminal part of a tentacular arm, which was taken by Capt. J. W. Collins and crew, of the schooner "Marion," from the stomach of a large and voracious fish (*Alepidosaurus ferox*) together with the only specimen hitherto discovered of the remarkable squid, *Histioteuthis Collinsii* V. The fish was taken on a halibut trawl-line, N. lat. 42° 49′; W. long. 62° 57′, off Nova Scotia, 1879. This fragment, after preservation in strong alcohol, now measures 18 inches in length. It includes all the terminal club, and a portion of the naked arm below it. The club is narrow, measuring but ·75 inch across its front side, while the naked arm is 1·25 broad, and rather flat, where cut off. From the commencement of the large suckers to the tip, it measures 9·25 inches. It had lost most of its suckers, so that it cannot be identified with certainty. Part of the large suckers and some of the marginal ones still remain, though the horny rings are gone; diameter of large suckers, ·50 inch; of marginal ones, about ·12. The suckers have the same form and arrangement as in the larger specimens of *Architeuthis*. It may, perhaps, belong to *Architeuthis megaptera*, or to a young *A. Harveyi*.

No. 21.—Cape Sable specimen. (*Architeuthis megaptera* V.)

Plate XXI.

This specimen was found thrown on the shore near Cape Sable, N. S., after a very severe gale, several years ago. It is preserved in alcohol, entire, and in good condition, in the Provincial Museum at Halifax, where it is well exhibited in a large glass jar. It is the type specimen of *Architeuthis megaptera*, described by me, Sept., 1878.* It is a comparatively small species, its total length being but 43

* American Journal of Science, xvi, p. 207, 1878.

inches; its head and body together, 19 inches; body alone, 14 inches; its tentacular-arms, 22 and 24 inches; short arms, from 6·5 to 8·5 inches; tail-fin, 13·5 inches broad and 6 long.

This species differs widely from all the others in the relatively enormous size and breadth of its caudal fin, which is nearly as broad as the body is long, and more than twice as broad as long. It will form the type of a new generic group.

No. 22.—Brigus specimen, 1879.

Mr. Harvey states that portions of another large squid were cast ashore near Brigus, Conception Bay, in October, 1879.

Two of the short arms, each measuring eight feet in length, were found with other mutilated parts, after a storm.

No. 23.—James's Cove specimen, 1879.

From Mr. Harvey I have also very recently received an account of another specimen, which was captured entire about the first of November last, at James's Cove, Bonavista Bay, N. F. It seems to have been a fine and complete specimen, about the size of the Catalina Bay specimen (No. 14). Unfortunately the fishermen, as usual, indulged immediately in their propensity to cut and destroy, and it is doubtful if any portion was preserved. The account referred to was published in the *Morning Chronicle*, of St. John's, N. F., Dec. 9, 1879, and was credited to the *Harbor Grace Standard*. The author of the article is not given. The following extract contains all that is essential: "A friend at Musgrave Town sends us the following particulars relative to the capture of a big squid at James's Cove, Goose Bay, about a month ago. Our correspondent says: Mr. Thos. Moores and several others saw something moving about in the water, not far from the stage. Getting into a punt they went alongside, when they were surprised to see a monstrous squid. One of the men struck at it with an oar, and it immediately struck for the shore, and went quite upon the beach. The men then succeeded in getting a rope around it, and hauled it quite ashore. It measured 38 feet altogether. The body was about 9 feet in length, and two of its tentacles or horns were 29 feet each. There were several other smaller horns, but they were not so long. The body was about 6 feet in circumference. When I saw it, it was in the water, and was very much disfigured, as one of the men had thoughtlessly cut off the two longest tentacles, and had ripped the body partly open, thereby completely spoiling the appearance of the creature. The foregoing particulars I obtained from Mr. Moores."

Histioteuthis Collinsii Verrill.

In addition to the foregoing examples, all of which are believed to be referable to the genus *Architeuthis*, I have in a former article* described a very remarkable squid, belonging to the genus *Histioteuthis*, in which a broad thin membrane or 'web' unites the six upper arms together, nearly to their tips, while the lower ones have a shorter web uniting them to the rest. Although small, when contrasted with some of the gigantic specimens of *Architeuthis*, it is considerably larger than any of the common small squids, and as it inhabits the same localities with *Architeuthis*, and has some points of resemblance to the latter genus, especially in having the smooth-rimmed suckers for uniting together the long tentacular-arms, I have thought it best to describe it in this part of my article, in connection with the species of *Architeuthis*. The only specimen known was obtained (with No. 20) from the stomach of a large and voracious fish (*Alepidosaurus ferox*), having a formidable array of long sharp teeth, eminently adapted for the capture of such prey. It was taken by Captain J. W. Collins and crew of the schooner Marion, in deep water off the coast of Nova Scotia, and presented to the U. S. Fish Commission. This species (*H. Collinsii*) is figured on Plate XXII, and will be described farther on.

Onychoteuthis robusta (Dall, MSS.).

In this connection I may also refer to a gigantic Pacific Ocean species, obtained by Mr. W. H. Dall, on the coast of Alaska, in 1872, which will be described as fully as possible in another part of this article, when discussing the foreign species of large Cephalopods, (see Plates XXIII and XXIV.) Three specimens were observed and measured by Mr. Dall. The largest measured, from the base of the arms to the end of the body, 8·5 feet. The ends of all the arms had been destroyed, in all the specimens. It was formerly† briefly described by me under Mr. Dall's MSS. name, *Ommastrephes robustus*, but a more careful study of the parts preserved, especially the 'cone' of the 'pen' and the odontophore, has convinced me that it belongs to the genus *Onychoteuthis*, characterized especially by having rows of sharp claws or hooks on the 'club' of the tentacular-arms, instead of suckers. All the species of this genus previously known are of small size, and pelagic in their habits. It is, therefore, of especial interest to add another generic type to the list of gigantic species.

* American Journal of Science, vol. xvii, p. 241, 1879.

† American Journal of Science, vol. xii, p. 236, 1876.

Comparative measurements of the specimens (in inches).

	Architeuthis Harveyi?									Architeuthis princeps?									
	No. 2.	No. 3.	No. 4.	No. 5. Fresh.	No. 5. Presv'd.	No. 8.	No. 9.	No. 11.	No. 15.	No. 1.	No. 7.	No. 10.	No. 13.	No. 14.	No. 16.	No. 18.	No. 19.	No. 22.	No. 23.
Total length, to tip of tentacular-arms,	--	624	384	382	--	480	540	--	--	--	624	--	450?	480	528	660	--	--	456
Total length, to tip of short arms,	--	--	--	166	--	--	--	--	--	--	--	--	--	246	--	--	--	--	--
Base of arms to insertion of tail-fin,	--	--	--	75	--	--	--	--	--	--	--	--	120	95	--	--	--	--	--
Base of arms to tip of tail,	--	120	--	92	--	--	--	168?	--	170?	180	--	140?	114	132	240	180	--	108
Head, length (base of arms to mantle),	--	--	--	10	--	--	--	--	--	--	--	--	--	14?	--	--	--	--	--
Mantle edge to tip of tail, above,	--	--	--	82	--	--	--	--	--	--	--	--	--	100?	--	--	--	--	--
Circumference of body.	--	90?	72	66	--	--	--	--	--	56?	--	--	--	84	--	--	144	--	72
Circumference of head,	--	--	--	--	--	--	--	--	--	--	--	--	36	48	--	--	--	--	--
Breadth of head, across eyes,	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
Breadth of eye-openings,	--	--	--	--	--	--	--	--	7 × 9	--	--	--	--	8	--	--	--	--	--
Length of tail-fins, (tip to insertion),	--	--	--	18?	17	--	--	--	--	--	--	--	20?	19 p.	--	--	--	--	--
Breadth of tail-fins,	--	--	--	22	16	--	--	--	18	--	--	--	--	28 p	--	--	--	--	--
From outer angle to tip of tail-fins,	--	--	--	27?	23	--	--	--	--	--	--	--	--	24·5p.	--	--	--	--	--
Outer angle of tail-fin to side of body,	--	--	--	--	6·5	--	--	--	--	--	--	--	--	10 p.	--	--	--	--	--
Length of tentacular-arms,	348?	504	--	288	161	--	--	384	--	--	444	--	312	360	396	420	--	--	348
Length of 'club,' bearing rows of suckers,	30	--	--	30	30	--	--	--	--	--	--	--	--	30·5p.	--	--	--	--	--
Part bearing largest suckers,	18	--	--	15	14	--	--	--	--	--	--	--	--	19 p.	--	--	--	--	--
Length of longest sessile arms,	--	72	--	72	--	--	--	120	--	120 +	--	--	104?	132	156?	--	192	96	--
Circumf. of largest sessile arms (at base),	--	9	--	10	3	--	--	--	10·5	22	--	--	16?	17	--	--	--	--	--
Breadth of largest sessile arms (at base),	--	--	--	--	8	--	--	--	3·5?	--	--	--	--	6	--	-	--	--	--
Circumf. of tentacular-arms (middle),	4	--	--	2½–3	2·75	--	--	--	--	--	--	--	--	5	--	--	--	--	--
Circumference of 'club' of same,	6	--	--	--	4·5	--	--	--	--	--	--	--	--	6 p.	--	--	--	--	--
Diameter of largest suckers, of club,	1·28	--	·92	1·25	1·15	--	--	2·25?	--	--	2	--	1·10	1·15	--	--	--	--	--
Diameter of largest suckers of short arms,	--	--	--	1	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
Upper jaw, total length,	--	--	3·55	--	3·85	--	--	--	--	--	--	5	4 +	5·25	--	--	--	--	--
Upper jaw, breadth (front to back),	--	--	2·5+	--	2·50	--	--	--	--	--	--	3·50	3·24	3·88	--	--	--	--	--
Lower jaw, total length.	--	--	--	--	3	--	--	--	--	--	--	3·63	3·24	3·75	--	--	--	--	--
Lower jaw, total breadth,	--	--	--	--	2·65	--	--	--	--	--	--	--	3 08	3·88	--	--	--	--	--
Lower jaw, tip of beak to notch,	--	--	.62	--	·65	--	--	--	--	65	--	·80	·71	·87	--	...	--	--	--

* The measurements given from the preserved specimen of No. 14 are designated by (p) affixed.

Special Descriptions of the Atlantic Coast Species.

Architeuthis Steenstrup.

Oplysninger om Atlanter, Collossale Blæksprutter. Förhandlinger Skand. Naturf., 1856, vii, p. 182, Christiana, 1857.

Size large. Body stout, nearly round, swollen in the middle. Caudal fin, in the typical species, very small, sagittate (very large, broad, rhomboidal in *A. megaptera*).* Head large, short. Eyes very large, oblong-ovate with well-developed lids and anterior sinus. Sessile arms stout, their suckers large, very oblique, with the edges of the horny rings strongly serrate, especially on the outer margin. The margin has around it a free-edged membrane, which closely surrounds the denticles when the sucker is used, and allows a vacuum to be produced. Tentacular-arms very long and slender, in extension, the proximal part of the club furnished with an irregular group of small, smooth-rimmed suckers, intermingled with rounded tubercles on each arm, the suckers on one arm corresponding with the tubercles of the other, so that, by them, the two arms may be firmly attached together without injury, and thus used in concert; other similar suckers and tubercles, doubtless for the same use, are distantly scattered along the slender part of these arms, one sucker and one tubercle always occurring near together. The internal shell (known only in one species) is thin and very broad, expanding from the anterior to the posterior end, with divergent ribs.

This genus is closely allied to *Ommastrephes*, from which it may be best distinguished by the presence of the peculiar suckers and tubercles for uniting the tentacular-arms together. A small cluster of smooth-edged suckers also occurs at their tips.

Architeuthis Harveyi Verrill.

Megaloteuthis Harveyi Kent, Proc. Zool. Soc. London, 1874, p. 178.

Architeuthis monachus Verrill, Amer. Journal Science, vol. ix, pp. 124, 177, Pl. ii, iii, iv, 1875; vol. xii, p. 236, 1876. American Naturalist, vol. ix, pp. 22, 78, figs. 1–6, 10, 1875, (*? non* Steenstrup).

Ommastrephes harveyi Kent, Proc. Zool. Soc. London, 1874, p. 492.

Ommastrephes (*Architeuthis*) *monachus* Tryon, Manual of Conchology, I, p. 184. Pl. 83, fig. 379, Pl. 84, figs. 380–385, 1879. (Descriptions compiled and figures copied from the papers by A. E. V.)

Plates XIII, XIV, XV, XVI, XVI*a*.

The diagnostic characters of this species, so far as determined, are as follows: Sessile arms unequal in size, nearly equal in length,

* This species differs so much in dentition and other characters from the typical forms, as to deserve separation, as a subgenus, or perhaps as a distinct genus, which I propose to call *Sthenoteuthis*.

decidedly shorter than the head and body together, and scarcely as long as the body alone, all bearing apparently similar suckers; their tips slender and acute. Tentacular-arms, in extension, about four times as long as the short ones; about three times as long as the head and body together. Caudal fin small, less than one-third the length of the mantle, sagittate in form, with the narrow lateral lobes extending forward beyond their insertions; the posterior end tapering to a long acute tip. Jaws with smaller notch and lobe than in *A. princeps*. Suckers of the sessile arms (so far as seen) with numerous acute teeth all around the circumference, all similar in shape, but those on the inner margin smaller than those on the outer. Sexual characters are not yet determined.

Special description of the specimen, No. 5.—The preserved parts of this specimen (see p. 184), examined by me, are as follows: The anterior part of the head, with the bases of the arms, the beak, lingual ribbon, etc.; the eight shorter arms, but without the suckers, which dropped off in the brine, and are now represented only by a few of the detached marginal rings; the two long tentacular-arms, which are well preserved, with all the suckers in place; the caudal fin; portions of the 'pen' or internal shell; the ink-bag; and pieces of the body.

The general appearance and form of this species* are well shown by Plates XIII and XIV. The body was relatively stout. According to the statement of Mr. Harvey, it was, when fresh, about 213^{cm}

* Mr. W. Saville Kent, from the popular descriptions of this species, gave it new generic and specific names, viz: *Meyaloteuthis Harveyi*, in a communication made to the Zoological Society of London, March 3, 1874 (Proceedings Zool. Soc., p. 178; see also Nature, vol. ix, p. 375, March 12, and p. 403, March 19). My former identification was based on a comparison of the jaws with the jaws of *A. monachus*, well figured and described by Steenstrup in proof-sheets of a paper which is still unpublished, though printed several years ago, and referred to by Harting. The agreement of the jaws is very close in nearly all respects, but the beak of the lower jaw is a little more divergent in Steenstrup's figure. His specimen was a little larger than the one here described and was taken from a specimen cast ashore at Jutland, in 1853. Mr. Kent was probably unacquainted with Steenstrup's notice of that specimen when he said (Nature, ix, p. 403) that *A. monachus* "was instituted for the reception of two gigantic Cephalopods, cast on the shores of Jutland in the years 1639 and 1790, and of which popular record alone remains." In his second communication to the Zoological Society of London, March 18, 1874, (Proc., p. 490), he states (on the authority of Crosse and Fischer) that a third specimen "was stranded on the coast of Jutland in 1854, and upon the pharynx and beak of this, the only parts preserved; the same authority founded his species *Architeuthis dux*." The specimen here referred to is

(seven feet) long and five and one-half feet in circumference. The 'tail' or caudal fin (Plate XIII, fig. 2, and Plate XVI, fig. 2) is decidedly sagittate, and remarkably small in proportion to the body. It is said by Mr. Harvey to have been 55·9^{cm} (22 inches) across, but the preserved specimen is considerably smaller, owing, undoubtedly, to shrinkage in the brine and alcohol. The posterior termination is unusually acute and the lateral lobes extend forward considerably beyond their insertion. In the preserved specimen the total length, from the anterior end of the lateral lobes to the tip of the tail, is 58·4^{cm} (23 inches); from the lateral insertions to the tip, 48·2^{cm} (19 inches; total breadth about 38^{cm} (15 inches); width of lateral lobes, 15·2^{cm} (6 inches). The eight shorter arms, when fresh, were, according to Mr. Harvey's measurements, 182·9^{cm} (six feet) long and all of equal length,* but those of the different pairs were respectively 25·4,

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evidently the same that Steenstrup named *A. monachus*, in 1856. The confusion in reference to these names is evidently due to this mistake.

The statement that *Architeuthis dux* Steenstrup is known from the beak alone is evidently erroneous. Steenstrup, himself, Harting, and Dr. Packard, in their articles on this subject, all state that the suckers, parts of the arms, and the internal shell or pen were preserved, and they have been figured, but not published, by Prof. Steenstrup. Harting has also given a figure of the lower jaw, copied from a figure by Steenstrup. In the proof-sheets that I have seen, this specimen is referred to as "*A. Titan*," but Harting cites it as *A. dux* Steenstrup, which is the name given to it by Steenstrup in his first notice of it, in 1856. Therefore two distinct species were confounded under this name by Kent.

I have more recently been led to consider our species distinct from the true *A. monachus* by correspondence with Professor Steenstrup, from whom I learn that the caudal fin in his species does not agree with that of the species here described, and that in his species the ventral arms differ from the others, both in form and in the character of the suckers. Certain differences in the arms can be detected in the photograph of our specimen (reproduced on Plate XIII) in which, fortunately, the ventral arms are well-displayed; but their suckers do not appear to differ, except in size. Unless these differences prove to be sexual characters, which is not likely, they would indicate a specific difference. Therefore, I have, for the present, adopted the specific name given by Kent to the Newfoundland specimens. The name was given, as a well-merited compliment to the Rev. M. Harvey, who has done so much to bring these remarkable specimens into notice. Nevertheless it is probable that when the original specimens of *A. monachus* shall have been fully described and figured, one of our species may prove to be identical with it. At present I am unable to decide whether the affinities of *A. monachus* may not be with *A. princeps*, rather than with *A. Harveyi*. With the former it apparently agrees in having two forms of suckers on the short arms.

* It is possible that they may have been originally somewhat unequal, and that mutilation of their tips made them appear more nearly equal than they were in life.

22·9, 20·3 and 17·8^{cm} (ten, nine, eight and seven inches) in circumference.* They are, except the ventral, compressed trapezoidal in form and taper very gradually to slender acute tips. Their inner faces are occupied by two alternating rows of large obliquely campanulate suckers, with contracted apertures, surrounded by broad, oblique, thin, horny, marginal rings, much broader on the outer side than on the inner, and armed with strong, acute teeth around their entire circumference, but the teeth are largest and most oblique on the outside (Plate XVI, fig. 4; XVI*a*, figs. 6–8). These suckers gradually diminish in size to the tips of the arms, where they become very small, but all that are preserved are similar in form and structure. The ventral pair of arms still have, as they show in the photograph, the inner face much broader than it is in the others, especially near the base, and they are more nearly square than any of the others. Their suckers are more numerous, farther apart transversely, and closer together in the longitudinal series, there being about 46 on the proximal half (36 inches) of each, while on each of the subventral arms there are only about 30 on the corresponding portion; the suckers also diminish rather abruptly in size at about 26 to 30 inches from the base, beyond which they are scarcely more than half as large as those on the second and third pairs of arms, at the same distance from the base. The largest of these suckers are said, by Mr. Harvey, to have been about an inch in diameter, when fresh. The largest of their marginal rings, in my possession, are 14^{mm} to 16^{mm} in diameter, at the serrated edge, and 18^{mm} to 20^{mm} beneath.

The horny rings are yellowish horn-color, oblique, and more than twice as wide on the back side as in front. A wide peripheral groove runs entirely around the circumference, just below the denticulated margin; it is narrower and deeper on the front side. On the front side the edge is nearly vertical, and the denticles point upward or are but slightly incurved; but on the outer or back side the edge and denticles are bent obliquely inward; along the side the edge is more or less incurved and the denticles are inclined more or less forward, toward the front edge of the sucker. The denticles are golden yellow, or when dry, silvery white; those on the outer and lateral

* In the original statement it is not mentioned to which pairs of arms these dimensions apply. After having been five years in alcohol the ventral arms now measure 7·5 inches in circumference, and one of the lateral ones (perhaps one of the third pair) 8 inches. The marginal membranes or crests had decayed, apparently, before the arms were preserved; their terminal portions are also gone, so that the real length cannot be given.

margins are largest, flat, lanceolate, with sharply bevelled lateral edges and acuminate tips; those on the front margin are shorter, narrower, acutely triangular, and in contact at their bases. On the largest of these suckers there are forty-eight to fifty denticles. Some of the suckers of rather smaller size (*a*, *b*,) are more oblique, with the outer side of the horny rings relatively wider and more incurved; the denticles of the outer margin are strongly incurved and decidedly narrower and more acute than the lateral ones, which are broad-triangular; the inner or front denticles are rather smaller, acute-triangular, and usually inclined somewhat inward. On these there are forty to forty-six denticles. No suckers of this specimen have been found with the denticles rudimentary or wanting on the front edge, as is frequently the case in those of *A. princeps*. Nor is there so much contrast in the form and size of the inner and outer denticles of the largest suckers as in that species. The rings of the smaller suckers are still more oblique and more contracted at the aperture than those of the larger ones, with the teeth more inclined inward, those on the outside margin being largest.

Measurements of suckers of short arms (millimeters).

	a (alc.)	*b* (alc.)	*c* (alc.)	*d* (dry.)
Transverse diameter, outside,	17	17	20	18
Diameter of aperture,	13	10	16	14
Breadth of horny ring, back side,	7·5	9	8	7
Breadth of horny ring, front side,	3	3	3·5	3
Number of distinct denticles,	46	41	50	49

The two long tentacular-arms are remarkable for their slenderness and great length when compared with the length of the body. Mr. Harvey states that they were each 731·5^{cm} (24 feet) long and 7^{cm} (2·75 inches) in circumference when fresh. In the brine and alcohol they have shrunk greatly, and now measure only 411·5^{cm} (13·5 feet) in length, while the circumference of the slender portion varies from 5·7^{cm} to 7·25^{cm} (2·25 to 3·25 inches). These arms were evidently highly contractile, like those of many small species, and consequently the length and diameter would vary greatly according to the state of contraction or relaxation. The length given (24 feet) probably represents the extreme length in an extended or flaccid condition, such as usually occurs in these animals soon after death. The slender portion is nearly three-cornered or triquetral in form, with the outer angle rounded, the sides slightly concave, the lateral angles prominent, and the inner face a little convex and generally smooth.

The terminal portion, bearing the suckers, is 76·2^{cm} in length and expands gradually to the middle, where it is 11·4^{cm} to 12·7^{cm} in circumference (15·3^{cm} when fresh), and 3·9 to 4·1^{cm} across the inner face. The sucker-bearing portion may be divided into three parts. The first region occupies about 17·8^{cm} (7 inches): here the arm is rounded-triquetral, with margined lateral angles, and gradually increases up to the maximum size, the inner face being convex and bearing about forty irregularly scattered, small, flattened, saucer-shaped suckers, attached by very short pedicels, and so placed in depressions as to rise but little above the general surface. The larger ones are 5 to 6^{mm} in external diameter; 3^{mm} across aperture; 1·5^{mm} high. The smaller ones have a diameter of 4^{mm}; aperture 2·5^{mm}; height 1^{mm}. The horny ring (Plate XVI*a*, figs. 9, 9*a*) is circular, thin, and of about uniform breadth all around; the edge is smooth and even, slightly everted; just below the edge there is a groove all around; below this a prominent, rounded ridge surrounds the periphery, below which the lower edge is somewhat contracted. A thick, soft membrane surrounds the edge. These suckers are at first distantly scattered, but become more crowded, distally, forming six to eight irregular alternating rows, covering the whole width of the inner face, which becomes 4·1^{cm} broad. Scattered among the suckers are about an equal number of low, broad, conical, smooth, callous verrucæ, or wart-like prominences, rising above the general surface, their central elevation corresponding in form and size to the apertures of the adjacent suckers. These, without doubt, are intended to furnish secure points of adhesion for the corresponding suckers of the opposite arm, so that, as in some other genera, these two arms can be fastened together at this wrist-like portion, and thus may be used unitedly. By this means they must become far more efficient organs for capturing their prey than if used separately. The absence of denticulations prevents the laceration of the creature's own flesh, which the sharp teeth of the other suckers would produce, under pressure, and the verrucæ prevent the lateral slipping, to which unarmed suckers applied to a smooth surface would be liable. Between these smooth suckers and the rows of large ones there is a cluster of about a dozen small suckers, with sharply serrate margins, from 5 to 8^{mm} in diameter, attached by slender pedicels. They are arranged somewhat irregularly in four rows, those of the outer rows more oblique and corresponding in form with the larger marginal suckers.

The second division, 35·6^{cm} in length, succeeds the small suckers. Here the arm is flattened on the face, well-rounded on the back, and provided with a sharp dorsal carina, increasing in width toward the tip. It bears two alternating rows of about twelve very large serrated suckers, and an outer row of smaller ones, on each side, alternating with the large ones. The upper edge is bordered by a rather broad, regularly scalloped, marginal membrane, the scallops corresponding to the large suckers, while prominent transverse ridges, midway between the large suckers, join the membrane and form its lobes. On the lower edge there is a narrower and thinner membrane, which runs all the way to the tip of the arm. In one (the lower) of the rows of large suckers there are eleven, and in the other ten, above 20^{mm} in diameter. The former row has one additional sucker at its proximal end 15^{mm} in diameter, and three others at its distal end, respectively 16, 12, and 8^{mm} in diameter. The other row, of ten suckers, is continued by a proximal sucker 10^{mm} in diameter, and by two distal ones, respectively 15 and 13^{mm} in diameter. The number of 'large' suckers in each row may, therefore, be counted as 12, 13, or 14, according to the fancy of the describer, there being no well-defined distinction between the larger and smaller ones in either row. The largest suckers, along the middle of the rows, are from 24^{mm} to 30^{mm} in diameter (Plate XVI, fig. 3, *a*). They are attached by slender but strong pedicels, about 10^{mm} long and 6 to 7^{mm} in diameter. The outer or back side of these suckers is 16 to 18^{mm} high; the front side 10 to 11^{mm}, so that the rim is about 24 to 28^{mm} above the surface of the arm. The horny rings are 7 to 8^{mm} high and have the aperture 20 to 25^{mm} in diameter. Each one is situated in the center of a pentagonal depressed area, about 25^{mm} across, bounded by ridges, which alternate regularly, and interlock on the two sides, so as to form a zigzag line along the middle of the arm. These large suckers are broadly and obliquely campanulate, but much less oblique than those of the short arms; the marginal ring is strong, and sharply serrate all around; the denticles are acute-triangular and nearly equal. The rings are somewhat calcified and rather rigid when dried; a well-marked broad groove runs around the entire circumference, below the bases of the denticles.

The small marginal suckers (fig. 3, *b*) are similar in structure, but much more oblique, and mostly 9 to 11^{mm} in diameter; they are attached by much longer and more slender pedicels, and their marginal teeth are relatively longer, sharper and more incurved, especially on the outer margin. The peripheral groove is broad and deep,

but is interrupted on the outer side for about a third of the circumference; the outer third portion of the horny ring is somewhat flattened from the circular form.

The terminal division of the arm is 22·8^{cm} long. It gradually becomes much compressed laterally, and tapers regularly to the tip, which is flat, blunt and slightly incurved. Just beyond the large suckers, where this region begins, the circumference is 9^{cm}. The face is narrow and bears a large number of small pedicellate suckers, (Plate XVI*a*, figs. 10, 10*a*) arranged in four regular, alternating rows, gradually diminishing in size to near the tip of the arm, where the rows expand into a small cluster of about ten smooth-edged suckers. The suckers, except in the final group, are much like the marginal ones of the previous division, and at first are 5 to 7^{mm} in diameter, but decrease to about 2·5^{mm} near the tip of the arm. They have sharply serrate, oblique, marginal rings, broader on the outer side, with a peripheral groove on the front and sides only. In our preserved specimens the rings are gone from many of these small suckers, but those of the two rows next to the lower margin appear to have been larger than the others.

The suckers of the final group are close to the tip, which is slightly recurved over them. They are flat, attached to short pedicels, and provided with a narrow horny rim, which has the edge smooth, or nearly so, and surrounded by a thick membranous border. The diameter of these suckers is from ·5 to 2^{mm}. They are rather crowded and the cluster is broader than long.

The color of the body and arms, where preserved, is pale reddish, with thickly scattered small spots of brownish red.

The form of the jaws* of this specimen is well shown by Plate XV, figs. 1 and 2. When in place the tips of these jaws constitute a pow-

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* In order to explain the terms employed in describing the various parts of the jaws of Cephalopods, as used in this article, I have introduced figures of the jaws of one of our common small squids (*Loligo pallida* V.) from Long Island Sound. The nomenclature adopted is essentially that used by Professor Steenstrup.

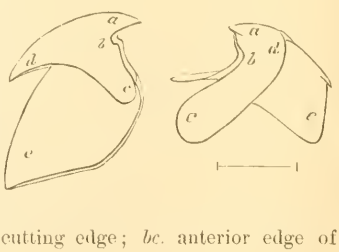


Figure 1. Upper mandible: *a*. rostrum or tip of the beak; *b*. the notch; *c*. the inner end of ala; *d*. the frontal lamina; *e*. the palatine lamina: *ab*. the cutting edge of beak; *bc*. anterior or cutting edge of ala.

Figure 2. Lower mandible: *a*. rostrum; *ab*. cutting edge; *bc*. anterior edge of ala; *d*. mentum or chin; *e*. gular lamina.

erful beak, looking something like that of a parrot or hawk, except that the upper jaw shuts into the lower, instead of the reverse, as in birds. The color is dark brown, becoming almost black toward the tip, where its substance is thicker and firmer and smoothly polished externally. The upper jaw (Plate XV, fig. 1), in 1875, measured 97^{mm} in total length; 25^{mm} in transverse breadth; and 66^{mm} in breadth or height. The lower jaw (fig. 2) was 76^{mm} long, 70^{mm} transversely, and 67^{mm} broad, vertically. It was larger when first received, but has subsequently shrunk considerably more, in alcohol.

The upper mandible has the rostrum strong, convex, acute, and curved considerably forward, with concave cutting edges, and a slight notch at its base. The anterior edges of the alæ are irregular and uneven. The palatine lamina is broad and thin.

The lower mandible has the rostrum stouter and less curved, the tip acute, with a distinct notch just below the tip, the cutting edges nearly straight, and with a moderately deep and rather narrow notch at its base; a ridge runs backward, from near the tip, in a curved line, circumscribing a more flattened area, on which are grooves and ridges parallel with the notch. Beyond the notch, on the anterior edges of the alæ, there is, on each side, a broad, low, obtuse lobe or tooth, beyond which the edge is even and slightly concave, to near the end of the alæ. The lamina of the mentum is short and strongly emarginate in the median line. Detailed measurements of the parts are given in the table of measurements on a subsequent page.

The roof of the mouth, or palate, between the anterior portions of the palatine laminæ, is lined with a rather firm, somewhat chitinous or parchment-like membrane,* having its surface covered with strong, acute, recurved, yellowish teeth, apparently chitinous in nature, attached by broad, oval or roundish, flattened bases (Plate XVI, fig. 1; XVI*a*, fig. 4). These teeth are mostly curved, and very unequal in size and form, the various sizes being intermingled. They are arranged in irregular quincunx, in many indefinite rows. Many irregular, roundish, rough, white, stony granules are also attached to this membrane, among the teeth. Similar granules (Plate XVI*a*, fig. 5) occur in large numbers on the thinner extension of this membrane, which everywhere lines the mouth and pharynx.

* In my first examination of this species, this tooth-bearing membrane was found, like the surrounding parts, much mutilated, and was mistaken for the odontophore, and described and figured as such. The real odontophore was discovered later, loose in another can, with other fragments of the same specimen, and this serious mistake was corrected in the American Journal of Science, vol. xii, p. 236, 1876.

The odontophore is about 64^{mm} in total length, with the dentigerous portion, where widest, about 11^{mm} in width. The teeth are in seven rows, with an exterior row of small, unarmed, thin, rhomboidal plates on each side, thus conforming to the arrangement in the other ten-armed cephalopods. The teeth are deep amber-color to dark brown, and not unlike those of *Loligo* and *Ommastrephes* in form. Those of the median row have three fangs, the central one longest; those on the next row, on either side, have two fangs; while those of the two outer lateral rows, on each side, are acute and strongly curved; the outermost longest and simple, the next to the outer often having a small denticle on the outer side, near the base. (See Plate XVI*a*, figs. 1, 2, 3.)

The membrane of the odontophore is broad, firm and thick; the dentigerous portion occupies only about a third of its width, in the middle or broader portion, where it is bent abruptly back upon itself. The lower or ventral portion measures, from the anterior bend to the end, 20^{mm}; it narrows gradually to the broad obtuse end, the width of the dentigerous portion decreasing from 9 to 5^{mm}, the naked lateral membrane decreasing from 8^{mm} to a very narrow border. The upper portion, from the bend to the end, measures 42^{mm} in length (in a straight line). The upper surface is deeply concave and infolded, at first, with the lateral membrane broad and recurved; farther back it becomes more flattened, with the dentigerous portion broader (11^{mm}), while the lateral membrane is abruptly narrowed and then extends to the end as a very narrow border. Toward the end the rows of teeth become more separated and the teeth smaller and paler, while the membrane becomes thinner and narrower.

The internal shell, or 'pen,' was represented by numerous detached pieces, which, after much trouble, I succeeded in locating and matching, so as to restore both the anterior and posterior ends, and thus to gain a fair idea as to what its original structure must have been. The texture, form and structure of the pen was somewhat like that of *Loligo*, but it was thinner, and had less definite outlines, and less of the peculiar quill-shape seen in the latter. The posterior end, instead of being pointed and regular in outline, appears to have been broadly rounded, or somewhat truncated, with an indefinite outline, thinning out gradually on all sides into a soft fibrous membrane, while the shaft, or quill-portion, was not so distinctly differentiated from the broader central portion, but increased in width quite regularly, from near the anterior end. The fragments in my possession belong to four more or less separated sections. The first section includes eleven

inches of the anterior end, from close to the extreme tip backward; the second section includes about nine inches, belonging to the anterior portion, and extends to about twenty-five inches from the anterior end, but lacks the extreme lateral margins, outside the costæ (Plate XV, fig. 3); the third section consists of about 7·5 inches belonging to the middle region, but does not include the whole width on either side of the midrib; the fourth section is about 10 inches in length, and comes from close to the posterior end, apparently representing nearly the whole width, on both sides.

From these fragments we can restore, pretty accurately, the first twenty-five inches, and the last twelve inches or more, though the precise form of the indefinite posterior margin must remain doubtful. The extreme anterior tip is broken off, but it was evidently pointed and pen-shaped, as in *Loligo*. At the mutilated end the breadth is now about a third of an inch. From this point the lateral edges diverge rapidly with a slightly concave outline, for about 1·25 inches, where the breadth becomes 1·20 inches; beyond this the margins are nearly straight and diverge gradually to the end of the first section, at eleven inches from the tip. At this place the breadth is 3·10 inches, the marginal portions, outside of the lateral costæ, being about ·40 of an inch, and the midrib about ·25 of an inch broad. Beyond this point a section about 4·75 inches long is entirely wanting, and the succeeding section lacks the marginal portions, the lateral costæ forming the margins on both sides. At 19·50 inches from the tip, the breadth, between the lateral costæ, is 3·75 inches; at 25 inches it is 5 inches broad. Whether the marginal portions originally extended to this point with a breadth as great as they have at 11 inches is uncertain, for their breadth decreases backward to that point from a point about 4 inches from the tip, where their breadth is ·60 of an inch. The midrib is strongly marked, being raised into a semi-cylindrical form, and of somewhat thicker material than the lateral portions; its breadth and height steadily increases throughout both these sections and the following one, until it becomes nearly half an inch broad, but in the section from near the posterior end it is low and narrow and decreases rapidly toward the end. The lateral costæ are well-marked, considerably elevated, and well rounded; they run, at first, close to and nearly parallel with the midrib, but after the first three inches they diverge quite regularly to the point, at 25 inches from the end, beyond which we cannot trace them, until they reappear in the first part of the posterior section, where they are quite small and soon fade out entirely, at some distance from

the extreme end. Near the anterior end, between the principal costæ and the margin, there are two additional costæ, much less distinct, and many faint radiating lines on each side. But these diverge more rapidly and mostly run into the margin at six to eight inches from the anterior end. The anterior portions and posterior portions are pale yellow or buff, fading to whitish at the thin margins, and deepening into pale amber at the midrib. Their substance is flexible, translucent, and very thin—scarcely thicker than parchment, except at the midrib and costæ.

The third section evidently came from the middle region, where the shell was thickest and broadest. This piece is 7·50 inches long, and 4·10 broad, with a strongly convex midrib, ·30 to ·35 of an inch broad, running through the center, but without any lateral costæ. In this portion the shell is much thicker and firmer than in the others, and of a decided brownish yellow, or dull amber-color, but quite translucent; it is finely striated with close, nearly parallel lines. The breadth and form of this middle portion must remain undetermined, for the present. The posterior section is quite incomplete, but is over ten inches long, and shows an extreme width of about six inches, or 5·75 where the lateral costæ disappear. Some of the fragments extend backward eight inches or more beyond that point, and gradually fade out, both at the ends and lateral margins, into a white, soft but tough, fibrous membrane. So far as this portion is preserved, it indicates a broadly rounded and ill-defined posterior termination.

To this species I refer, with some doubt, the tentacular-arm of No. 2, preserved in the museum of St. John's, Newfoundland. It agrees essentially in form and size, as will be seen from the description and measurements, with the corresponding arms of No. 5. Still it must be remembered that, as yet, no reliable distinctions have been made out between the tentacular-arms of *A. Harveyi* and *A. princeps*.

The total length of the tentacular-arm of No. 2 was estimated at 30 to 35 feet. The portion saved measured, when fresh, 579·12^{cm} (19 feet). The circumference of the slender portion was 9 to 10^{cm}; of the enlarged sucker-bearing part, 15·24^{cm} (6 inches); length of the part bearing suckers, 76·2^{cm} (30 inches); diameter of the largest suckers, 3·17^{cm} (1·25 inches). Calculating from the photograph, the portion bearing the larger suckers was about 45·7^{cm} (18 inches) in length, and about 6·35^{cm} (2·5 inches) broad, across the face; distance between attachments of large suckers, 4·27^{cm} (1·68 inches); outside diameter of larger suckers, 2·95 to 3·18^{cm} (1·16 to 1·25 inches); inside

diameter, 1·86 to 2·54^{cm} (·74 to 1 inch); diameter of the small suckers of the outside rows, 1·02 to 1·22^{cm} (·40 to ·48 of an inch). Mr. Harvey afterwards sent to me a full series of measurements of this arm, as then preserved. It had contracted excessively in the alcohol, and was only 13 feet one inch in length (instead of 19 feet, its original length), the enlarged sucker-bearing portion being 27 inches; the large suckers occupied 12 inches; the terminal part bearing small suckers, 9 inches; circumference of slender portion, 3·5 to 4·25 inches; of largest part, 6 inches; breadth of face, among large suckers, 2·5 inches; from face to back, 1·62 inches; diameter of largest suckers outside, ·75 of an inch; aperture, ·63 of an inch. It will be evident from these measurements, when compared with those made while fresh and from the photograph, that the shrinkage had been chiefly in length, the thickness remaining about the same, but the suckers (which had lost their horny rims, and therefore their size and form,) were considerably smaller than the dimensions previously given. Comparing all these dimensions with those of the Logie Bay specimen, and calculating the proportions as nearly as possible, it follows that this specimen was very nearly one-third larger than the latter, but the large suckers appear to have been relatively smaller, for they were hardly one-twelfth larger than in the Logie Bay specimen. As the relative size of the large suckers is a good sexual character in certain species of squids, it is possible that this difference may be a sexual one, in this case.

To this species I formerly referred the jaws and two large suckers from the 'club' of the tentacular-arms of the Bonavista Bay specimen (No. 4, see p. 194). In form, size, and proportions the jaws resemble those of the specimen (No. 5), described above, so that the size of these two individuals must have been about the same. These jaws had been dried and were very badly broken when received, so that only part of their dimensions could be ascertained, at first, but I have recently partially repaired them, so as to study them more fully, (see table under *A. princeps*). The total length of the upper mandible was about 105^{mm}. Tip of beak to notch 16^{mm}; notch to end of proper cutting edge of alæ, 75^{mm}. The lower mandible (Plate XXV, figs. 5, 5*a*) shows both sides of the rostrum and alæ. The notch and tooth are well-marked, and the tooth in front of it is narrower and much more elevated on one side than on the other. It is, therefore, quite possible that it belongs to *A. princeps*. The suckers (Plate XVI, figs. 5 and 6) had been dried, and have lost their true form, but the marginal rings are perfect, and only 23·4^{mm} (·92 of an inch) in

diameter, but though somewhat smaller than in the specimen just described, they have the same kind of denticulation around the margin. Their smaller size may indicate that the specimen was a male, but they may not have been the largest of those on the arm.

Architeuthis princeps Verrill.

Architeuthis princeps Verrill, Amer. Journ. Science, vol. ix, pp. 124, 181, Plate V, 1875; American Naturalist, vol. ix. pp. 22, 79, figs. 25–27, 1875.

Ommastrephes (Architeuthis) princeps Tryon, Manual of Conchology, p. 185, Pl. 85, 1879 (figures copied and description compiled from papers by A. E. V.).

Plate XVII, Plate XVIII, Plate XIX, Plate XX.

This species is distinguished by the length and inequality of the short arms, of which the longest (ventral or subventral) exceed the combined length of the head and body by about one-sixth; by the denticulation of the suckers of the short arms, of which there are two principal forms, some having very oblique horny rings with the outer edge very strongly toothed and the inner edge slightly or imperfectly denticulated; the others having less oblique rings with the denticles similar in form all around, though smaller on the inner margin; by the stronger jaws, which have a deeper notch and a more elevated tooth on the anterior edge; and by the caudal fin, which is short-sagittate in form, with the posterior end less acuminate than in the preceding species.

This species was originally based on the lower jaw, mentioned as No. 1, and on the upper and lower jaws, designated as No. 10, in the first part of this article. The jaws of No. 10 were obtained from the stomach of a sperm whale taken in the North Atlantic, and were presented to the Essex Institute by Capt. N. E. Atwood, of Provincetown, Mass., but the date and precise locality of the capture are unknown. The size and form of these jaws is well shown in Plate XVIII, figs. 1, 2. The total length of the upper jaw (fig. 1) is 127^{mm} (5 inches); greatest transverse breadth, 37^{mm} (1·45 inches); front to back, 89^{mm} (3·5 inches); width of palatine lamina, $58{\cdot}9^{mm}$ (2·32 inches). The frontal portion is considerably broken, but the dorsal portion remaining appears to extend nearly, but not quite, to the actual posterior end, the length from the point of the beak to the posterior edge being $86{\cdot}4^{mm}$ (3·4 inches). The texture is firmer and the laminæ are relatively thicker than in *A. Harveyi*. The rostrum and most of the frontal regions are black and polished, gradually becoming orange-brown and translucent toward the posterior border, and marked with faint striæ radiating from the tip of the beak, and

by faint ridges or lines of growth parallel with the posterior margin; a slight but sharp ridge extends backward from the notch at the base of the cutting edge, and other less marked ones from the anterior border of the alæ. The tip of the beak is quite strongly curved forward, and acute, with a slight shallow groove, commencing just below the tip, on each side, and extending backward only a short distance and gradually fading out. The front or cutting edge is nearly smooth and well curved, the curvature being greatest toward the tip; at its base there is a broad angular notch, deepest externally. The inner face of the rostrum is convex in the middle and concave or excavated toward the margins, which are, therefore, rather sharp. The anterior borders of the alæ are convex, or rise into a broad, but low, lobe or tooth beyond the notch, but beyond this they are nearly straight, but with slight, irregular lobes, which do not correspond on the two sides. The anterior edges of the alæ make nearly a right angle with the cutting edges of the rostrum. The palatine lamina is broad, thin, and dark brown, becoming reddish brown and translucent posteriorly, with a thin, whitish border. The surface is marked with unequal divergent striæ and ridges, some of which, especially near the dorsal part, are quite prominent and irregular; the posterior border has a broad emargination in the middle, but the two sides do not exactly correspond.

The lower jaw (Plate XVIII, fig. 2) was badly broken, and many of the pieces, especially of the alæ, are lost, but all that remain have been fitted together. The extreme length is 92^{mm} (3·63 inches); the total breadth, and the distance from front to back cannot be ascertained, owing to the absence of the more prominent parts of the alæ; from tip of beak to posterior ventral border of mentum, $42·6^{mm}$ (1·68 inches); from tip of beak to posterior lateral border of alæ, $55·9^{mm}$ (2·20 inches); from tip of beak to posterior ventral border of gular lamina, 60^{mm} (2·37 inches); from tip of beak to bottom of notch at its base, 20^{mm} (·80 inch); tip of beak to inner angle of gular lamina, 47^{mm} (1·85 inches); height of tooth from bottom of notch, $6·25^{mm}$ (·25 inch); breadth between teeth of opposite sides, 15^{mm} (·60 inch); breadth of gular lamina, in middle, $44·5^{mm}$ (1·75 inches). The beak is black, with faint radiating striæ, and with slight undulations parallel with the posterior border; the rostrum is acute, slightly incurved, with a notch near the tip, from which a very evident groove runs back for a short distance, while a well marked angular ridge starts from just below the notch, and descends in a curve to the ala, opposite the large tooth, defining

a roughened or slightly corrugated and decidedly excavated area between it and the cutting edges; the cutting edge below this ridge is nearly straight, or slightly convex; the notch at its base is rounded and deep and strongly excavated at bottom; the tooth is broad, stout, obtusely rounded at summit, sloping abruptly on the side of the notch, and gradually to the alar edge. The anterior edge of the alæ, beyond the tooth, is rounded and strongly striated obliquely; it makes, with the cutting edge, an angle of about 110°. The inner surfaces of the two sides of the internal plate of the rostrum form an angle of about 45°.

The lower jaw of No. 1 (Plate XVIII, fig. 3) is represented only by its anterior part, the alæ and gular laminæ having been cut away by the person who removed it.* It agrees very well in form and color with the corresponding parts of the one just described, but is somewhat smaller. The lateral ridges of the rostrum are rather more prominent, and the area within it is narrower and more deeply excavated, especially at the base of the notch, where the excavation goes considerably lower than the inner margin. The notch is narrower and not so much rounded at its bottom. The tooth is about the same in size as that of No. 10, and appears to be even more prominent, because the anterior edge of the alæ is more concave at its outer base; it is also more compressed and less regularly rounded at summit. This jaw measures 32·5^{mm} (1·30 inches) from the tip to the posterior ventral border of mentum; 17^{mm} from the tip to the bottom of the notch; 4^{mm} from bottom of notch to tip of the tooth.

Both these lower jaws agree in having a very prominent tooth on the alar edge, with a large and deeply excavated notch between it and the cutting edge of the beak, and in this respect differ from the lower jaw of *A. Harveyi*, for in the latter the tooth or lobe is broad and less prominent, while the notch is narrower and shallower. This seems to be the best character for distinguishing the jaws of the two species. But they also differ in the angle between the alar edge and the cutting edge of the rostrum, especially of the lower jaw, for while in *A. Harveyi* this is hardly more than a right angle, in *A. princeps* it is about 110°. Moreover, the darker color and firmer texture of the jaws of the latter seem to be characteristic.

To this species I have referred the Catalina specimen (No. 14, p. 189), preserved in the New York Aquarium. The jaws of the latter, which were examined and carefully measured by me, agree very

* The specimen was given to the Smithsonian Institution by Mr. G. P. Whitman, of Rockport, Mass., in 1872. (No. 2524).

closely, both in form and size, with those of No. 10, the type of the species, but are a trifle larger. The total length of the upper mandible is 133^{mm}; greatest breadth, 99^{mm}; from inner angle of anterior edge to the dorsal end of frontal lamina, 95; tip of rostrum, or beak, to the dorsal end of frontal lamina, 92; tip of rostrum to bottom of notch, 19; notch to inner end of anterior edge, 38; transverse breadth between anterior edges, 17^{mm}.

The total length of the lower mandible is 95^{mm}; breadth, from gular lamina to inner end of alæ, 99; front edge of jaw to posterior end of gular lamina, 83; breadth of alæ, 41; posterior edge of alæ to end of gular lamina, 44·5; tip of beak to bottom of notch, ·22; notch to inner angle of alæ, 70; depth of notch, 3·5^{mm}.

The general form of this species is very well shown on Plate XX. This figure has been based upon the sketches and measurements made by me soon after the specimen was received in New York and before it had been "mounted" (see page 189). The head was, however, so badly injured that it could not be accurately figured, and this part is, therefore, to be regarded as a restoration, as nearly correct as could be made under the circumstances. It may require considerable corrections, both as to size and form. The caudal fin is remarkable for its small size, as in *A. Harveyi*. Its breadth is scarcely more than that of the greatest diameter of the body. It is short-sagittate in form, with strongly divergent side lobes, which extend forward beyond their lateral insertions, and end in a rounded or blunt angle. The posterior end is somewhat prolonged and acute, but less so than in that of *A. Harveyi*, which it otherwise resembles. One of the figures (Plate XIX, fig. 2), was made by me several weeks after it had been placed in strong alcohol, and had shrunk considerably; the other (fig. 1) was made by Dr. J. B. Holder after it had been in alcohol only a few days.

When fresh, the caudal fin was 84^{cm} in breadth, but when sketched by Dr. Holder its breadth was 71^{cm}; its length, from posterior tip to lateral insertions, 48·3^{cm}; from tip to end of lateral lobes, 61^{cm}.

The length of the body and head together, when fresh, was about 289^{cm} (9·5 feet); but when measured by me it was about 218^{cm}.

The sessile arms were unequal in size and length, the longer ones considerably longer than the head and body together. Mr. Harvey found that the longest arms, said to be the ventral ones, were 335^{cm} (11 feet) long, and 43·2^{cm} (17 inches) in circumference at base. When first examined by me the ventral arms measured 10·5 feet, and were longer than any of the others, but all the rest were more

or less mulitated at the tips, and several had thus lost a considerable portion of their length, so that it is quite probable that originally the sub-ventral arms (or third pair) were actually longer than the ventral ones. The circumference of the third pair of arms, when measured by me, was considerably greater than that of the ventral ones; the former being 11·25 inches; the latter 10 inches. Hence I have inferred that the greatest circumference (17 inches), measured by Mr. Harvey, applies to the third pair of arms.

The ventral arms have both outer angles bordered by a strong, thick marginal membrane, about an inch wide. The arms are all more or less trapezoidal in form, and taper to very slender tips. When examined by me they had already lost nearly all their suckers. A few remained near the base of one of the arms of the third pair. These were 25^{mm} (1 inch) in diameter, with the aperture 15·5^{mm} (·62 inch) across; the denticles on the outer border of the marginal ring were broad-triangular, acute, and strongly incurved, much larger than those on the inner margin.

Of the detached suckers, I have been able to study, with care, 18 specimens from the sessile arms. Part of these are represented only by the horny marginal rings. The three largest differ from the rest in having the denticles less incurved and more nearly alike all around the margin, those on the inner edge being only somewhat smaller and more slender than those on the outer margin, while the rings themselves are less oblique and eccentric. These may have come, perhaps, from the ventral arms, near the base. The other suckers all belong to one type, like those seen upon the third pair of arms, described above. They differ, however, very much in size, in the number of denticles, and in the presence or absence of more or less perfect denticles on the inner margin, this, in the smaller ones, often being without any distinct denticles whatever; the horny rings are very oblique and the aperture eccentric. The diameters vary from 8^{mm} to 24^{mm} externally; the apertures from 3·5^{mm} to 20^{mm}.

One of the most perfect of these suckers (*b*) is preserved in alcohol with the soft parts (Plate XVII, figs. 5, 6), and was sent to me from Newfoundland by Mr. Harvey. This has a greater external diameter of 22^{mm}; diameter of aperture, 10^{mm}; height of cup (outside), 16^{mm}; height at center, 15^{mm}, height near inner margin, at attachment of pedicel, 6^{mm}; length of pedicel, 14^{mm}; diameter of pedicel, 1·5^{mm}. In a side-view the sucker is oblique and gibbous; the lower surface is convex centrally, but has a deep notch or pit near the front margin, in the bottom of which the slender but strong pedicel is attached,

and the horny ring has a corresponding notch; the outer or back portion is much swollen and produced downward and backward, and here the horny ring is correspondingly broad. The aperture is nearly circular, but is rather shorter from front to back than transversely. In this and some of the other suckers of similar size, the entire circumference of the margin is furnished with rather large sharp denticles which are strongly inclined inward and considerably larger on the outer than on the inner margin. There are about thirteen of the large teeth, occupying rather more than half the circumference; these are broad at base, bevelled off to an acute edge on the sides, and somewhat acuminate, with sharp tips. Those on the middle of the outer border point inward to the center of the sucker, but those along the sides point rather obliquely to the front margin. The front margin is occupied by about seventeen smaller, unequal, acute, denticles, those in its center the smallest and most regular; these are acute-triangular and their points are directed more upward than those of the opposite edge. The horny rings are light yellow (when dried they are white and osseus), their denticles yellowish white, and often silvery white and lustrous at tip and along their edges, especially when dried. The suckers smaller than the above have fewer of the larger outer teeth, and usually fewer and less perfectly formed teeth along the front margin. Those that have the aperture 7^{mm} or less in diameter usually have the front margin of the ring only irregularly fissured, with the intervals minutely denticulate or crenulate, while the outer half of the margin may bear nine or ten large and well-developed denticles, with broad stout bases and sharp edges and tip; the edges of these teeth along the middle are usually convex, and then the outline is incurved to the acute point. One of the smaller suckers examined has the aperture about $4{\cdot}5^{mm}$ in diameter, with the same form as the larger ones; this has about six large, sharp, denticles, like those above described, on the outer half of the margin of the rings, while the front margin is nearly entire and smooth. The smallest one (*j*) is similar, with but four distinct, large denticles, with another imperfect, lobe-like one, on one side, and with a smooth front margin.

The three largest suckers, (Plate XVII, fig. 9), supposed to be from near the base of the ventral arms, have about 45 marginal denticles, of nearly uniform size, and less incurved than in those above described. In these the back side of the horny ring is less expanded, and therefore the suckers were less oblique than in the smaller ones. The largest of these (*a*) had the aperture 20^{mm} in diameter.

Measurements of suckers of short arms (millimeters).

	a.	*b.*	*c.*	*d.*	*e.*	*f.*	*g.*	*h.*	*i.*	*j.*
Transverse diameter, outside,	24	21	20	20	17	16	16	10	9·5	8
Diameter of aperture, inside,	20	10·5	9	9	8·5	8	7	5	4·5	3·5
Breadth of horny ring, back side,	10	....	11	12	11	11	11	...	7	5
" " " front side,	5	....	3·5	3	3	2·5	3	...	2	1·5
Number of large denticles,	23	13	12	12	9	12	10	7	6	4
Number of small denticles,	22	17	10	17	12	15	...	...	....	....

The long tentacular-arms agree very closely with those of *A. Harveyi* (No. 5) in form and in the arrangement of the suckers on the 'club.' When fresh they measured 914·4^{cm} (30 feet) in length with a circumference of about 12·7^{cm} (5 inches), except at the enlarged club, which was 20·32^{cm} (8 inches) in the middle. But when first examined by me they had shrunk to 731·5^{cm} (24 feet) in length, and the circumference of the slender portion was 9 to 10^{cm}; that of the club was 15·24^{cm} (6 inches). At that time the 'club' was 77·47^{cm} (30·5 inches) long; that portion bearing the larger suckers was 48·26^{cm} (19 inches); the wrist or portion bearing the smaller and partly smooth-rimmed suckers and tubercles was 15·24^{cm} (6 inches) long; the terminal portion, bearing small denticulated suckers was 22·86^{cm} (9 inches); the breadth of the front of the club was 7·62^{cm} (3 inches). The terminal portion had a strong carina-like membrane or crest along the back, and was here 5^{cm} (2 inches) wide, from front to back.

The large suckers (Plate XVII, figs. 1, 1*a*) of the tentacular-arms are nearly circular in outline, and are broad, depressed, little oblique, constricted just below the upper margin, and then swelled out below the constriction to the base. The calcareous ring is strong, white, and so ossified as to be somewhat rigid and bone-like. The margin is surrounded by numerous (about 45 to 50) nearly equal, acute-triangular teeth, sometimes separated by spaces equal to their breadth, at other times nearly in contact at their bases; their edges are so bevelled as to be sharp; while there is a triangular thickening in the middle of each, at base. A wide, deep and concave groove extends entirely around the rim a short distance below the margin; below this the lower part of the rim is somewhat expanded and irregularly plicated, varying in width. The largest ring studied by me measures 31^{mm} in its greatest diameter externally; the aperture is 26^{mm} and 23^{mm} across its longer and shorter diameters;* greatest

* This specimen is somewhat warped, by drying, so that the aperture is not so circular as when fresh.

height or breadth of rim, 11^{mm}; least height, 8^{mm}; breadth of groove, 1·5 to 2^{mm}.

The marginal suckers (Plate XVII, fig. 10), alternating with the large ones on the 'club,' are very oblique, with the rings strong and very one-sided, the height of the back being more than twice that of the front margin. The aperture is not circular, the outer portion of the margin being incurved or straight. The groove below the margin is narrow and deep, especially on the sides, but only extends around the front and sides, being entirely absent on the outer third of the circumference. The denticles are about 22 to 24, slender, acute, not crowded, the most of them being separated by spaces greater than their breadth at base. The outer ones are strongly incurved; those along the sides are curved forward obliquely toward the front margin, while those on the front margin point upward and sometimes rather outward. The denticles are of nearly equal length, but those of the front margin are both more slender and more acute; they all have sharp bevelled edges and a thickened median ridge or tubercle. The largest ring examined was 14^{mm} in diameter, height or breadth of back side of rim, 8^{mm}; of front side, 3·5^{mm}.

The small suckers, covering the last division of the club, are very similar to the marginal ones last described, except that they are much smaller and more delicate, with a narrower and less oblique rim. The denticles of the inner margin are very acute and point obliquely outward and upward. Greatest diameter of the one described, 6^{mm}; height of back side of rim, 4^{mm}; of front side, 1·5^{mm}.

The small terminal group of smooth-rimmed suckers, seen in No. 5, were not noticed, but they were not looked for specially.

To this species I have also referred the specimen (No. 13) from Grand Bank, Fortune Bay, (see page 188, where the general measurements are given). Fortunately, Mr. Simms was able to obtain the jaws in pretty good condition, and also one of the largest suckers of the tentacular-arms. These specimens were forwarded to me by the Rev. M. Harvey. They had been dried, and the jaws, which were still attached together by the ligaments, had cracked somewhat, but all parts were present, except the posterior end of the palatine lamina, which had been cut or broken off. Although these jaws had undoubtedly shrunken considerably, even when first received, they were afterwards put into alcohol and have since continued to shrink, far more than would have been anticipated, so that, at present, the decrease in some of the dimensions amounts to 20 per cent., while even

the harder portions have decreased from 5 to 10 per cent. from the measurements taken when first received by me.* When first received in 1875, the upper mandible measured 111^{mm} in total breadth (front to back); 88^{mm} from tip of beak to anterior end of palatine lamina; 20^{mm} from tip of beak to the bottom of the notch. The lower mandible measured 96^{mm} in total length; 80^{mm} from tip of beak to inner end of alæ; 19^{mm} from tip to bottom of notch.

At the present time (Jan., 1880), the breadth of the upper mandible is about 90^{mm}; from tip of beak to anterior end of palatine lamina (at junction with anterior edge of alæ) 89^{mm}; tip of beak to bottom of notch, 19^{mm}; breadth of palatine lamina, 58^{mm}; beak to posterior end of frontal lamina, 90^{mm}; beak to posterior lateral edge of alæ, 43^{mm}; notch to end of anterior edge of alæ, 33^{mm}; notch to end of hardened or black portion of same (proper cutting edge), 17^{mm}; transverse breadth at notches, 16^{mm}. The lower mandible measures, in length, 82^{mm}; beak to inner end of alæ, 67; to bottom of notch, 18; breadth, alæ to mentum, 78; end of alæ to outer side of gular lamina, 84; inner side of gular to mentum, 50; breadth of gular, 44; breadth of alæ, anterior to posterior edge, laterally, 29; tip of beak to posterior ventral end of mentum, 33; tip to posterior lateral border of alæ, in line with cutting edge of rostrum, 45^{mm}; posterior lateral border of alæ to end of gular, 40; depth of notch, 3; breadth of tooth, 8; notch to end of cutting or hardened edge of alæ, 20; to inner end of alæ, 55; breadth transversely, across teeth, 16^{mm}, (see also table of measurements of jaws).

The beak of the upper mandible is sharp, strongly and regularly curved, most so near the tip; a radial ridge runs from the notch to the lateral border of the alæ; the anterior or cutting edges of the alæ are somewhat convex and irregularly crenulate. The lower mandible has a sharp beak, with a slight notch close to the tip; the cutting edges of the rostrum are otherwise nearly straight; the notches at the base are deep and narrow V-shaped. The teeth are rather prominent, obtuse, slightly bilobed at the summit; the one on the right side of the mandible is more prominent than the other, owing to the fact that the edge of the ala, beyond it, is more concave in outline. There is also a broad and slightly prominent lobe in the middle of the

* There is no reason to suppose that the shrinkage has been any more in this case than in the others, but I have not had an opportunity for making comparative measurements from the same specimens when recently preserved, and again after long preservation in alcohol, except in one other instance (No. 5), in which a similar shrinkage was evident.

anterior edge of the alæ. The sides of the rostrum are strongly excavated toward the base and around the notches, and radially striated. The jaws are dark brown, becoming blackish toward the tips.

Comparative measurements of jaws (in inches).*

	A. Harveyi.			A. princeps.				
	No. 4.	No. 5. Rec.	No. 5. Later.	No. 1.	No. 10.	No. 13 Fr'sh	No. 13. Pres'd.	No. 14.
Upper mandible:								
Length, beak to end of palatine,	3·55	--	3·85	--	5·	--	3·75+	5·25
Greatest breadth, palat. to frontal,	2·49+	2·84	2·60	--	3·50+	4·50	3·54+	3·88
Greatest transverse diameter,	--	--	1	--	1·45	--	1·15	--
Inner end of alæ to dorsal end of froutal,	--	--	2·50	--	3+	--	2·95+	3·75
Tip of beak to same,	2·37+	--	2·55	--	3·40+	--	3·17	3·62
Tip to anterior end of palatine lamina,	--	2·06	--	--	--	3·57	--	--
Tip to bottom of notch,	·63	·69	·61	--	·75	·81	·75	·75
Notch to end of anterior edge of alæ,	--	--	1·10	--	1·15	--	1·30	1·50
Transverse breadth at notch,	·60	--	--	--	--	--	·63	--
Transverse breadth between edges of alæ,	--	--	--	--	--	--	1	·69
Breadth of palatine lamina,	--	--	1·70	--	2·32	--	2·30	--
End of palatine to edge of frontal lamina,	--	--	2·20	--	3·15	--	--	3·50
Beak to posterior edge of alæ, laterally,	--	--	1·40	--	1·95+	--	1·70	--
Lower mandible:								
Total length, beak to end of gular,	--	3·44	3	--	3·63	3·89	3·24	3·75
Mentum to inner end of alæ,	2·60+	--	2·55	--	--	--	3·08	--
Total breadth, gular lamina to end of alæ,	--	--	2·65	--	--	--	3·32	3·88
Breadth of gular lamina,	--	--	1·50	--	1·75	--	1·74	--
Anterior edge of alæ to end of gular lamina,	--	--	2·45	--	3·15	--	2·68	3·25
Tip of beak to end of mentum, medially,	--	--	·85	1·30+	1·68	--	1·31	--
Tip to end of gular lamina, medially,	--	--	1·85	--	2·37	--	2·40	--
Breadth of alæ (laterally),	1·18	--	·93+	--	1·50	--	1·15	1·62
End of gular lamina to alæ, laterally,	--	--	1·50	--	1·60	--	1·58	1·75
Tip of beak to bottom of notch,	·62	·69	·60	·67	·80	·77	·71	·87
Tip to post. edge of alæ, laterally,	1·67	--	1·50+	--	2·20	--	1·78	--
Tip to inner end of alæ,	2·33	2·63	2·10+	--	--	3·45	2·67	--
Tip to inner angle of gular lamina,	1·20	--	1·18	--	1·85	--	1·28	--
Notch to inner angle of alæ,	1·92	--	1·77	--	--	--	2·17	2·75
Depth of notch,	·12	--	·12	·15	·15	--	·12	·13
Breadth of tooth in front of notch,	·30	--	--	·35	·32	--	·32	·38
Spread of jaws, between teeth,	--	--	--	--	·60	--	·64	--

* Nos. 1 and 10 had been dried for many years; all the others had been preserved in alcohol: Nos. 4 and 13 for several years; No. 5 about one year; No. 14 for only a few days. The amount of shrinkage is considerable in those preserved long in alcohol, or dried.

Comparative measurements of Architeuthis Harveyi and A. princeps (in inches).

	No. 5, A. Harveyi.		No. 2. A. Harveyi.		No. 14. A. princeps.	
	Fresh.	Pres'd.	Fr'h.	Pres'd.	Fr'h.	Pres'd.
Total length, to tips of short arms,	166?	--	--	--	246	212
Total length, to tip of tentacular-arms,	382?	--	--	--	480	372
From base of arms to tip of tail,	92?	--	--	--	114	86
From base of arms to origin of fins,	75?	--	--	--	95	67
Head, from base of arms to mantle (above),	10?	--	--	--	14?	12
Body, edge of mantle to tip of tail (above),	82	--	--	--	100?	74
Tip of tail to insertion of fin,	18?	17	--	--	--	19
Breadth of caudal fin,	22	16	--	--	33	28
From end of body to outer angle of fin,	27?	23	--	--	--	24·5
Front edge of fin, outer angle to side of body,	2--	6·5	--	--	--	10
Circumference of body,	66	--	--	--	84	66
Circumference of head,	--	--	--	--	48	
Length of tentacular-arms,	88	161	348?	--	360	289
Length of sucker-bearing portion,	30	30	30	27	36	30·5
Length of dorsal arms (1st pair),	72?	--	--	--	--	81+
Length of lateral arms (2d pair),	72?	--	--	--	--	100+
Length of lateral arms (3d pair),	72?	--	--	--	--	76+
Length of ventral arms (4th pair),	72	--	--	--	132	126
Circumference of 1st pair of arms, at base,	7	--	--	--	--	9
Circumference of 2d pair of arms, at base,	8	--	--	--	--	9·50
Circumference of 2d pair, 3 ft. from base,	--	--	--	--	--	7·50
Circumference of 3d pair, at base,	10	8	--	--	17	11·25
Circumference of 3d pair, 3 ft. from base,	--	--	--	--	--	9
Circumference of 4th pair, at base,	9	7·5	--	--	--	10
Circumference of 4th pair, 4 ft. from base,	--	--	--	--	--	8·5
Circumference of tentacular-arms,	3·75	2·75	4	3½–4¼	5	4
Circumference of terminal club of same,	--	4·5	6	6	8	6
Diameter of largest sucker of tentacular-arms,	--	1·15	1·28	1·25	1·25	1
Diameter of largest sucker of sessile arms,	1	·84	--	--	1	1
Aperture of latter,	--	·68	--	--	·80	·80
Details of tentacular-arms:						
Length of 'club' or expanded portion,	31	30	30	27	--	30·5
Of part of club bearing 24 largest suckers,	15	14	18	14	--	19
Of 'wrist' or part with group of small suckers,	7	7	--	--	--	6
Of terminal part, with small suckers,	9	9	--	9	--	9
Breadth of 'club' in middle,	--	1·5	2·5	2·5	--	3
Breadth of wrist,	--	1·6	2·6	1·5	--	3
Breadth of slender middle portion,	--	1·15	--	--	--	1·5
Breadth of tip (from front to back),	-	1·75	--	1·5	--	2
Circumference of club,	--	4·5	--	5·5	--	6
Circumference of wrist,	--	5	--	6	--	6
Circumference of middle portions of arm,	2⅜–3½	2¼–3¼	--	3½–4¼	--	3½–4
Distance between pedicels of large suckers,	--	1·15	1·68	1·44	--	
Distance between pedicels diagonally,	--	1	1·32	1·31	--	
Details of suckers of 'club':						
Largest suckers, diameter in middle,	1·25	1·15	1·28	1·24	1·25	
Largest suckers, diameter of horny ring,	--	·92	--	--	1·15	1·15
Diameter of facets around suckers,	--	1	--	1·40	--	1·25
Largest suckers, height from attachment,	--	1	--	--	--	·75
Largest suckers, length of pedicels,	--	·40	--	--	--	·50
Largest suckers, height of ring,	--	·32	--	--	--	·42
Secondary suckers, next to wrist, diameter,	--	·24	--	--	--	·44
Marginal suckers, diameter of rings,	--	.40	--	·48	--	·60
Marginal suckers, height of rings, outer side,	--	·28	--	--	--	·35
Sessile suckers of wrist, diameter,	--	·12	--	·28	--	--
Suckers of terminal section, diameter,	--	¼–1/10	--	--	--	--

The dried sucker from the tentacular-arm appears to have been one of the largest, (Plate XVII, fig. 11). At the present time the transverse diameter of the ring, outside, is 28^{mm}; diameters of the edge, 24 and 22^{mm}; greatest breadth of the ring, including denticles, 9·5^{mm}; least breadth, on inner side, 6·5^{mm}. There are 48 marginal denticles, which are nearly the same in size and form, all around. They are narrow, triangular, acute, with the edges bevelled sharp, and with a central, thickened, triangular ridge on the outside. The ring is white, hard, smooth, and osseous in appearance.

Of the other specimens enumerated in the first part of this paper, it is probable, judging from the proportions given, that Nos. 16, 18, and 19 also belonged to *A. princeps*. Nos. 18 and 19 appear to have been much larger than any of the examples of which portions have been preserved, and it was very unfortunate that the persons who secured them did not know their value, for they were both found within a few miles of the settlement at Little Bay Copper Mine, on the south arm of Notre Dame Bay, and could easily have been taken to St. John's.

Additional note on the suckers of Architeuthis Harveyi.

After printing the description of *A. Harveyi* some additional loose sucker-rims, from specimen No. 5, were found. Among these are some of the second or oblique kind, described as existing on the sessile arms of *A. princeps*. Therefore the remarks (on p. 201), in respect to the supposed absence of suckers on the former, will no longer hold good. These suckers of the second kind differ, however, from the corresponding ones of *A. princeps* in having, on the outer margin, more numerous, more slender and sharper teeth, which taper regularly from base to tip and are not so flattened. The larger of these sucker-rims (*i*) are 14·5^{mm} in diameter, across the base; aperture, 9^{mm}; height at back, 7^{mm}; in front, 2^{mm}; number of large denticles on outer margin, 10 to 14; the inner margin, except in the smaller ones, is either finely toothed or distinctly crenulated, and there are usually one or more irregular, broad, sharp, lobes or imperfect teeth on the lateral margins. The teeth of the outer margin are regular, strongly incurved, tapering from the base to the very sharp tips, and sharply bevelled on the edges. A smaller one (*j*) 11^{mm} across the base, and 4·5 across the aperture, with height of back, 6^{mm}, has five regular sharp teeth on the outer margin; two broad irregular ones on each side, while the front edge is nearly entire.

With these there were also some of the largest and least oblique

of the suckers, some of them (*e*, *g*) slightly exceeding the largest of those described on p. 201, but showing no distinct variation; others (*h*) are completely intermediate between the two principal forms, having very oblique rims, with a small aperture, but distinctly denticulate all around, the denticles on the inner margin being distinctly smaller than on the outer.

The following table of measurements will supplement those on page 201.

Measurements of sucker-rims from short arms (millimeters).

	e.	*f.*	*g.*	*h.*	*i.*	*j.*
Diameter, at base,	21	19	20·5	16	14·5	11
Diameter of aperture.	17	16	16·5	9·5	9	4·5
Height or breadth of ring, at back,	8	7·5	7·5	9·5	7	6
" " " front side,	3	3	3	3	2	1·5
Number of distinct denticles.	50	48	49	34	14	7

Sthenoteuthis, gen. nov.

(Type *Architeuthis megaptera* Verrill.)

This group is instituted to include certain species of squids, remarkable for the large size and high development of their organs of locomotion, especially of the caudal fin and siphon, and for the presence of a broad, thin web along the lower side of the lateral arms, outside the suckers.

The tentacular-arms are, like those of *Architeuthis*, very long, slender, and provided, at the base of the club, with smooth-rimmed suckers alternating with rounded tubercles, for the mutual adhesion of the two arms; the central part of the club is, as in *Architeuthis*, provided with two central rows of large serrated suckers, and a row of smaller marginal ones, on each side, of different form, alternating with them. The lateral arms have a well-developed median crest, (most developed on the third pair) along the outer side; on the lower inner angle there is a thin, membranous web, often more than twice as wide as the arm, along the whole length, much more highly developed than in typical *Ommastrephes*, in which a narrow marginal membrane occurs. On the ventral arms the inner face is broader than on the others, and the two rows of suckers are wider apart. The suckers on all the sessile arms are strongly denticulated on the outer side of the rim, with smaller or obsolete teeth on the inner side.

Caudal fin very large, rhomboidal. Internal bone or pen similar to that of *Ommastrephes*.

Odontophore with seven rows of teeth, median tooth with three

large denticles; inner lateral teeth with two unequal points; two outer laterals simple, slender. Eyes as in *Ommastrephes*.

This group is related on one side to *Architeuthis*, on the other to *Ommastrephes*. The armature of the tentacular-arms will distinguish it from the latter, and the large caudal fin and broad membrane of the sessile arms from the former.* The dentition of the type is peculiar, so far as known. In addition to the typical species, this genus will doubtless include several species with marginal webs, that have hitherto been referred to *Ommastrephes;* but they are mostly too indefinitely described and figured to show the special characters referred to. Thus, *O. pteropus* Steenstrup belongs to this genus, if a specimen from Bermuda, now in my possession, be correctly identified.†

Sthenoteuthis megaptera Verrill.

Architeuthis megaptera Verrill, Amer. Journ. Science, vol. xvi, p. 207, 1878. Tryon, Manual of Conchology, vol. i, p. 187 (description copied from preceding paper).

Plate XXI, figures 1–9.

Much smaller than the species of *Architeuthis*, the total length of the body and head being but nineteen inches. Body relatively short and thick. Caudal fin more than twice as broad as long, the length about half that of the body. Its form is nearly rhombic, with the lateral angles produced and rounded, and the posterior angle very obtuse, the posterior edge, as preserved, being slightly concave.

The ventral anterior edge of the mantle is concave centrally, with a slight angle to either side, about ·75 inch from the center; from these angles it is again concave to the sides; on the dorsal side the edge advances farther forward than beneath, terminating in a slightly prominent, obtuse angle in the middle of the dorsal edge. The external ear consists of a slightly elevated, transverse lamina, with three thicker and much more elevated laminæ which extend forward, on the head, one in the median line of the eye, with one above and one below it, the lower one longest and least elevated, curving downward beneath the head. The two upper ones are broadly rounded at top. Behind the transverse fold there is a deep, irregularly crescent-shaped fossa. The eye-sockets are large, oblong, and furnished with distinct

* According to the statement of Gervais, *Architeuthis dux* has similar membranes.

† *S. Bartramii* (*Ommastrephes Bartramii* (Leach) D'Orb.) also belongs to this genus, but is a more slender species. It has the characteristic smooth suckers and tubercles on the wrist of the 'club,' and a very broad caudal fin. It lives in the region of the Gulf Stream.

lid-like margins. The eyes are large, prominent, oblong, and naked; the anterior portion is swollen laterally on both sides. The short arms are trapezoidal, the dorsal ones somewhat shorter (about 1·25 inch) and smaller than the others, which are nearly equal in length, the second pair being stouter than the rest, and a little longer. The dorsal arms have a slightly prominent membrane along the outer angles; the subdorsal or upper lateral arms are narrowed to an acute edge or crest on the outer angle, but on the inner angle have a broad, thin, marginal membrane, outside the suckers. The lower lateral arms are similar in size and form, and also have a very broad, lateral, marginal membrane, next to the suckers, on the lower side. The ventral arms are more slender and a trifle longer, and have narrower marginal membranes. The tentacular-arms are slender, elongated, expanded toward the tip, and have suckers arranged much as in the gigantic species, even to the smooth-edged suckers and opposing tubercles, proximal to the large suckers, as I have described them in *A. Harveyi*. The sucker-bearing portion is margined by a membrane on each side.

The small proximal suckers of the tentacular-arms occupy about 44·5^{mm} (1·75 inches) at the commencement of the terminal club; they are about 1·5^{mm} in diameter, circular, regularly cup-shaped, with a nearly even, smooth rim; they are raised on slender pedicels. Alternating with these are smooth rounded tubercles, which are also on pedicels and slightly larger than the intervening suckers. There are four suckers and four tubercles in the row along the inner margin; along the outer margin there are fewer, smaller suckers, but without horny rings; if they originally had such rings they were probably smaller than the others. The large suckers (Plate XXI, fig. 9), forming the two central rows on the terminal club, are furnished with a somewhat oblique, dark brown ring, very strongly and sharply toothed around the outer portion of the edge, and usually with one tooth larger and longer than the rest, on the middle of the outer margin; inner margin with much smaller, very acute teeth, of unequal size. The teeth are gold-colored at tip.

Larger suckers of the sessile arms are very oblique, with the rim strong, dark brown, bearing large, strong, sharp, much incurved, unequal teeth on the outer side of the rim; the inner margin is entire. The ventral arms bear about 44 similar suckers, exclusive of the minute ones close to the end; the largest ones are situated beyond the middle of the arm. The lateral arms bear about the same number of large suckers, with numerous minute ones at the tip. The

dorsal arms bear, each, about 30 suckers, exclusive of the small terminal ones.

The 22d sucker of the left ventral arm (Plate XXI, figs. 8, 8*a*), has a strong, somewhat elliptical rim, with 7 strong and very acute incurved teeth on the outer side, and with the opposite margin on the inner side smooth for more than a third of the circumference. The median tooth on the outer margin is decidedly larger and longer than the others, and abruptly bent inward above its base. It is elongated and gradually tapered to the very acute tip, but thick and channelled externally at its base. To the right and left of this are three similar, but smaller, unequal teeth, all strongly curved inward toward the inner margin, (not convergent to the center). Of these the second from the central tooth, on each side, is the largest, and the third is the smallest. Between the latter and the smooth inner edge there is a small rounded lobe, or blunt tooth. Peduncle broad toward the rim, tapering rapidly to the slender base. Outer sides of rim much higher than inner. Greater diameter, 10^{mm}; lesser, 7^{mm}; greater interior diameter, 7^{mm}; total height, 13^{mm}; longest tooth, $2{\cdot}5^{mm}$.

The exposed portion of the upper mandible is black; the point is strongly curved, acute, with a smooth cutting edge, separated from the inner lobe by a deep, acute notch; inner lobe or edge of alæ thin, broadly rounded, with a slightly rounded, uneven edge. Length of mandible, 29^{mm}; distance from bottom of notch to tip, 10^{mm}; internal breadth between lobes, 8^{mm}.

The lining membrane of the palate (Plate XXI, fig. 2), is pale, translucent, covered with rather large, whitish, translucent teeth, variable in form and size, but mostly rather broad at base and tapering to an obtuse tip; some are more slender and acute. No granules were detected on the membrane.

The odontophore (Plate XXI, figs. 3–7), was too much injured to show its general form, but it appeared to resemble that of *A. Harveyi*. The lateral membrane was broad in the middle, translucent, white. No plates outside the lateral teeth could be detected. The teeth all have slender, acute tips. The median teeth have three points of equal length; the inner lateral ones have two points, the outer one considerably shorter and smaller than the other; the two outer lateral teeth are simple, long, acute, the outermost rather narrower at base and somewhat longer.

Total length, 109^{cm} (43 inches); length of body and head, $48{\cdot}2^{cm}$ (19 inches); length of body from dorsal edge of mantle, $35{\cdot}56^{cm}$ (14 inches); from ventral edge, $33{\cdot}16^{cm}$ (13 inches); of head from edge

Measurements of Sthenoteuthis megaptera and S. pteropus (in inches).

	S. megaptera. N. Scotia.	S. pteropus. Bermuda.	S. megaptera? Sable I. Bk.
Length, tip of tail to end of dorsal arms,	25·5	27·5	
" tip of tail to end of 3d pair	--	29·5	
" to end of tentacular-arms,	43	--	
" to base of arms,	19	20·5	
From base of arms to mantle,	5	6·25	
Tip of tail to edge of mantle (above),	14	14·75	
" " " (below),	13	14·5	
Tip of tail to center of eye,	--	18·5	
Length of caudal fin (tip to insertion),	6	6·75	
Breadth of caudal fin,	13·5	11·25	
Breadth between lateral insertions,	2·33	2	
End of body to outer angle of fin,	7	7·25	
Front edge of fin, from outer angle to insertion,	6·5	5·5	
Circumference of body,	12·5	11·5	
Breadth of body,	5	4·75	
Breadth of head,	4	3+	
Diameter of eye-opening (longitudinal),	1·25	1·75	
" " (transverse),	·75	1·25	
Length of tentacular-arms,	24	--	
Length of dorsal arms, (1st pair,)	6·5	7·25	
" subdorsal " (2d pair,)	8	8·75	
" subventral " (3d pair),	8·5	9·25	
" ventral " (4th pair.)	8	9·25	
Breadth of 1st pair of arms, at base,	·75	·75	
" 2d "	1·12	·80	
" 3d "	1·00	·90	
" 4th "	1·00	·90	
" tentacular-arms,	·33–·50	40–75	
" terminal club of same,	·75	--	
Length of siphon, in middle,	--	2·5	
Breadth of siphon, at base,	--	2	
Breadth of aperture of siphon,	--	1	
Details of tentacular-arms:			
Length of 'club,' or expanded part,	6·5	--	
" part bearing large suckers,	3·25	--	
" 'wrist,' bearing smaller suckers,	1·25	--	
" tip, with small suckers,	1·50	--	
Breadth of 'club,' in middle,	·75	--	
" middle of arm,	·50	--	
Details of suckers:			
Diameter of largest suckers of tentacular-arms,	·40	--	
" rims of same,	·32	--	
" largest suckers of dorsal arms,	--	·28	
" rims of same,	--	·20	
" largest suckers of 2d pair,	--	·40	
" rims of same,	--	·28	
" largest suckers of 3d pair,	--	·32	
" rims of same,	--	·24	
" largest suckers on ventral arms,	·40	·30	
" rims of same,	·32	·22	
Jaws:			
Upper mandible—total length,	1·16	1·68	1·25
" " tip of beak to bottom of notch,	·40	·40	·34
" " tip to dorsal edge of frontal lamina,	--	1·32	·98
" " breadth between anterior lobes of alæ,	·32	·32	·25
" " breadth of palatine,	--	·84	·70
Lower mandible—total length,	--	1·16	·91
" " depth, end of alæ to mentum,	--	1·12	·87
" " beak to notch,	--	·44	·31

of mantle to base of arms, 12·7^{cm} (5 inches); length of long tentacular-arms, 55·8 and 60·9^{cm} (22 and 24 inches) respectively; of first (dorsal) pair of arms, 16·5^{cm} (6·5 inches); of second pair, 20·3^{cm} (8 inches); of third pair, 21·6^{cm} (8·5 inches); of fourth pair, 20·3^{cm} (8 inches); length of caudal fin, 15·24^{cm} (6 inches); breadth, 34·3^{cm} (13·5 inches); transverse distance between insertions of caudal fins, 5·9^{cm} (2·33 inches); breadth across body in middle, 12·7^{cm} (5 inches); circumference of body, 31·7^{cm} (12·5 inches); length of eye-opening, 3·2^{cm}; its breadth, 1·9^{cm}; length of sucker-bearing portion of tentacular-arms, 16·5^{cm} (6·5 inches); of portion bearing large suckers, 8·25^{cm} (3·25 inches); breadth, 1·9^{cm} (·75 inch); length of terminal portion, 3·8^{cm} (1·5 inches); diameter of naked or peduncular portion, ·8 to 1·25^{cm}; breadth of dorsal arms at base, 1·9^{cm}; of second pair, 2·57^{cm}; of third pair, 2·54^{cm}; of fourth pair, 2·54^{cm}; diameter of largest tentacular suckers, 9^{mm} to 10^{mm}; of their rims, 7 to 8^{mm}; diameter of largest suckers of ventral arms, 10^{mm} (·40 inch); of their rims, 7 to 8^{mm}.

Color, in alcohol, reddish or purplish brown, speckled with darker brown, on the dorsal surface of body; upper side of head and outer sides of arms thickly covered with specks of purplish brown; inner surfaces paler, much as in the common small squids; sides yellowish brown, under surfaces yellowish brown, tinged with purplish.

This unique specimen was cast ashore, during a severe gale, near Cape Sable, N. S., several years ago, and was secured for the Provincial Museum at Halifax by J. Matthew Jones, Esq. It is preserved entire, in alcohol, and is still in good condition.

I refer doubtfully, to this species, an entire beak, with the odontophore, presented by Capt. Geo. A. Johnson and crew, of the schooner "A. H. Johnson." It was taken at Sable Island Bank, Nova Scotia, in 280–300 fathoms, Sept., 1878. This beak has the exposed parts black; the internal laminæ reddish brown. The upper mandible is sharp and strongly incurved, with a small narrow notch at its base, from which runs a raised lateral line; beyond the notch the anterior edge of the ala is convex and slightly uneven. The lower mandible has a small notch below the incurved tip; below this, the cutting edge is slightly concave to the basal notch, which is narrow on the right side, but broader and V-shaped on the left; beyond the notch the alar tooth is narrow, prominent and truncate on the right, but broader and blunt on the left. Opposite the notch and tooth the side of the beak is strongly excavated. Total length of upper mandible, 31^{mm}; height, palatine to frontal, 24; tip to bottom of notch, 8·5; tip to dorsal edge of frontal laminæ, 24·5; breadth between anterior lobes

of alæ, 6·2; breadth of palatine, 17·5. Total length of lower mandible, 23^{mm}; height, mentum to inner end of alæ, 22; tip to notch, 7·8; tip to end of mentum, 8·2; tip to dorsal end of gular, 16; transverse breadth at alar teeth, 7^{mm}. (See Plate XXVI).

The odontophore is similar to that of *S. megaptera*, but the lateral denticles of the median and inner lateral teeth are relatively shorter, and these, with some other differences, render it doubtful whether this beak can belong to that species. The odontophore is 4^{mm} broad; the teeth are all sharp, rather slender, pointed, and pale amber-color. A slight, smoothish, marginal ridge borders the dentigerous zone on each side, but is scarcely divided into distinct plates. The median teeth have three sharp, rather slender denticles, the median about a third longer than the lateral; the inner lateral teeth have a long point, with the acute outer denticle much shorter; the teeth of both outer rows are long, considerably incurved, acute, the outer ones the more slender.

Sthenoteuthis pteropus Verrill.

Ommastrephes pteropus Steenstrup?

Plate XXVI.

A large squid, 74·8^{cm} (29·5 inches) long from tail to tip of longest sessile arms, similar in size and form to the preceding, and closely allied to it, has been sent to me by Mr. G. Brown Goode, who collected it at Bermuda. It is probably the *Ommastrephes pteropus* of Steenstrup, but I have seen no full description of the latter, and figures only of the mandibles.

Our specimen is entire, except that it has lost the 'clubs' of the tentacular-arms. It is in fair condition, though considerably contracted by long preservation in too strong alcohol. The head, however, has been pulled out from the mantle to an unnatural extent, so as to increase the total length from 3 to 4^{cm}, at least. The ventral arms do not show any of the sexual modifications characteristic of the male squids, and, therefore, it is doubtless a female.

Most of the measurements are given in the table with those of *S. megaptera;* some of the more general are as follows: length from end of body to tip of dorsal arms, 69·8^{cm} (27·5 inches); to edge of mantle, dorsally, 37·5^{cm} (14·75 inches); to base of dorsal arms, 52^{cm} (20·5 inches); to center of eye, 47^{cm}; to lateral insertion of fin, length, 17^{cm} (6·75 inches); to outer angle of fin, along posterior edge, 18·4^{cm} (7·25 inches); breadth of fins transversely, 28·5^{cm} (11·25 inches); outer angle to lateral insertion, along front edge, 14^{cm} (5·5 inches); between

lateral insertions, 5^{cm} (2 inches); breadth of body, 11·9^{cm}; circumference of body, 29·2^{cm} (11·5 inches).

The body is stout, acuminate posteriorly; the anterior border of the mantle, beneath, is even, and not distinctly emarginate in the middle.

The caudal fin is large, broad, transversely rhomboidal, but neither so broad nor so large proportionally as in *S. megaptera*. The siphon is very large and broad, (63^{mm} long by 50 broad), with a large aperture, 25^{mm} wide. The eye-balls are very large, elongated, measuring, although somewhat collapsed, about 42^{mm} long by 31^{mm} broad. The eye-openings, as distended, are large, oblong, elliptical, with a broad sinus, and slightly thickened edges.

The arms are stout and rather long, the third and ventral pairs being nearly equal in length; those of the second pair are about 12·5^{mm} shorter than those of the third; the dorsal ones about 63^{mm} shorter than those of the second. The dorsal arms are 18·4^{cm} long, trapezoidal in form, the outer face convex and about 1·9^{cm} broad; the lateral and inner faces, 1·2^{cm}; along the inner angles there is a narrow membrane, outside the suckers. Those of the second pair are 24·7^{cm} in length; their transverse breadth is about 2^{cm}; from inner face to outer angle, 1·9^{cm}; along the outer angle, in these, is a thick acute-edged crest, widest in the middle of the arm; along the lower inner angle, outside the suckers, there is a broad and very thin membrane, 2·5^{cm} or more in width; along the upper inner angle, is a similar membrane, about ·6^{cm} wide.

The arms of the third pair are 26^{cm} long, (31^{cm} from center of eye to tip of arms); they are compressed, 2·25^{cm} broad at base; on the outer angle, along the middle, there is a very prominent crest, so that, in this part, the distance from inner face to outer angle, is 4^{cm}; along the lower-inner angle there is a very broad, thin, delicate web, where widest at least 5 to 7^{cm} (2 to 2·75 inches) wide, (it is considerably torn and may have been still wider); it is widest beyond the middle of the arm; on the upper-inner angle the corresponding membrane is about 0·6^{cm} wide. Transverse, thick, fleshy ridges run out from between the suckers a short distance on these membranes, and then fade out. The ventral arms are 2·25^{cm} broad at base, and trapezoidal; they have a smaller crest along the outer angle, and a narrow membrane along each inner angle.

All the sessile arms bear similar suckers, all of which are provided with 7 to 13 large, very acute, incurved teeth on the outer margin of the very oblique, horny rings, and with much smaller, sometimes rudimentary ones on the inner margin, much as in *S. megaptera*.

The largest of all the suckers are near the middle of the second pair of lateral arms, from the sixth to the sixteenth, and especially from the ninth to the fourteenth; the diameter of the ninth is 10^{mm}, the edge of its rim, 8^{mm}. On the dorsal arms the eighth to the thirteenth are the largest; the diameter of the ninth is 7^{mm}; edge of horny rim, 5^{mm}. On the third pair the eighth to the fourteenth are largest; the diameter of the tenth is 8^{mm}; its rim 6^{mm}. On the ventral arms the fourteenth to the twentieth are largest; the diameter of the fifteenth is $7{\cdot}5^{mm}$; its rim $5{\cdot}5^{mm}$. On the ventral arms the rows of suckers are more separated than on the others, its inner face being wider. On the lateral arms, toward the base, the two rows are nearer together, while the suckers of each row are distant, so that they almost form one irregular row, at first. The suckers are all very oblique, with the horny rims very low or narrow in front, and very high on the outer side; these rings are dark brown, but the teeth have a golden luster.

The thick fleshy margin, outside the denticulated edge of the horny ring, is completely covered all around, by a series of thin, bracket-shaped, horny plates, light brown in color, arranged radially and movable with the membrane to which they are attached for the most of their length; both the outer and the inner ends are free and turned upward, like a small tooth or denticle; those of the inner end are mostly acute, and form a circle of minute movable denticles, nearly in line with the large teeth of the horny ring, five to ten occupying the intervals between the large teeth of the largest suckers; those plates that stand opposite the teeth of the horny ring are shorter than the others, and often broader, and have no denticle on the flat or upcurved inner ends, which fit to the form of the base of the tooth in front of them; the outer ends are abruptly bent upward and often inward, forming a denticle or flattened hook, usually rounded at the end. These marginal plates vary greatly in width and form, even on the same sucker, according to position, and small, imperfectly developed, wedge-shaped ones are interpolated between the larger ones, around the periphery.

One of the largest suckers (the twelfth of the second pair of arms) has 22 teeth on the horny ring; of these five are small, but sharp, on the middle of the inner border; nine, on the outer border, are largest; and four, on each side, are intermediate in size. The median tooth on the outer margin is largest, and the one next to it, on each side, is a little smaller than the second one from it. The thirteenth sucker of the ventral arms has, on its rings, eighteen denticles; of these nine

are very large, with the median more decidedly the largest, and the one on each side of it is shorter as compared with the next; six, on the inner margin, are minute, and these are connected, by one or two somewhat larger ones, at each end of the inner border, with the larger series.

The stumps of the tentacular-arms are flattened, oval, and smooth, measuring about 10 by 18^{mm}, near the base; their length is about 28^{cm} (11 inches), which is doubtless less than half their original length.

The exposed parts of the jaws are black and polished; the laminæ are reddish brown, with broad, thin, yellowish-white margins. The upper mandible has a long sharp rostrum, with regularly curved cutting edges, and a small, well-defined, V-shaped notch, from which a short groove runs backward, beyond which there is a slight ridge; anterior edge of alæ, beyond the notch, forming no distinct lobe or tooth, but slightly convex, and irregularly crenulate; posterior lateral borders of alæ with a broad sinus in the middle; palatine lamina long and thin, with sinuous posterior margins; frontal lamina broad, extending well backward.

The total length of the upper mandible is 42^{mm}; tip to posterior end of frontal, 33^{mm}; to notch, 10^{mm}; greatest breadth (or height), from palatine to end of frontal, 30^{mm}; transverse breadth, across frontal, 15^{mm}; transverse breadth, across anterior edges of alæ, 8^{mm}.

The lower mandible has a strongly incurved beak, with the cutting edges rather suddenly incurved at about the proximal third, and a well-developed, broad, V-shaped notch at base, beyond which there is a slightly prominent, broad tooth; alæ broad, the inner ends broader than the middle, well-rounded; mentum short, with a broad dorsal emargination; gular lamina short, the inner edges incurved.

The total length of the lower mandible is 29^{mm}; tip of beak to end of mentum, 10^{mm}; to ventral end of gular, 21^{mm}; to bottom of notch, 11^{mm}; to inner ends of alæ, 24^{mm}; breadth, from inner ends of alæ to mentum, 28^{mm}; breadth of gular lamina, 17^{mm}; breadth of alæ, 12·5^{mm}; greatest transverse breadth, across alæ, 32^{mm}; transverse breadth, across anterior edges of alæ, at teeth, 11^{mm}.

These jaws agree pretty nearly, in form and size, with those of *O. pteropus*, figured by Steenstrup, but the latter have a deeper notch in the upper mandible, with a more evident lobe beyond it, while the lower mandible has a broader and less triangular notch.

The buccal membrane is large, thin, prolonged into seven acute angles or lobes, of which the upper is in the median plane, opposite

the interval between the dorsal arms; the six others are opposite the three other pairs of sessile arms. The inner surface of this membrane is covered, near the periphery, with small rounded papillæ; externally it is connected to the arm by seven membranous bridles, corresponding to the seven angles; of these the dorsal one forks, one branch going to the inner margin of each dorsal arm; the upper lateral ones join the marginal membrane of the upper angle of the upper lateral arms; the lower lateral ones join the lower marginal membrane of the third pair of arms; the ventral ones join the marginal membrane outside of the sucker-bearing face of the ventral arms. In front of the bases of each of the dorsal and tentacular arms there is a large opening to the space beneath this membrane.

The beak is closely surrounded by a thick, prominent, lobed and wrinkled, fleshy collar, with papillæ on its inner surface; outside of this there is a smooth, sharp-edged, erect collar, less prominent than the inner one.

The odontophore is similar to that of *Ommastrephes;* it is sharply bent upon itself anteriorly, with the ventral end less than half as long as the dorsal; the dentigerous zone is yellowish brown in color and bordered laterally by a thin ridge formed by a row of small plates; the lateral membrane is broad, thin, and pale yellow, running straight across, from the ventral end, at right angles to the dorsal portion, and then folding back upon itself, joins the dorsal part of the odontophore farther back, near its middle; beyond this point it is very narrow and rolled in. Length of the dorsal portion, 19^{mm}; of the ventral, 9; breadth of the dentigerous zone, anteriorly, 5^{mm}; breadth of marginal membrane, anteriorly, 7^{mm}.

The median teeth are broad, with three stout points, the middle one nearly twice as long as the lateral; the inner lateral teeth are much longer, with one long stout point and a short denticle on the outer side, below the middle; the two outer rows have simple, long, and rather stout, curved teeth, those of the outermost row a little longer and narrower than the others. The teeth differ decidedly from those of *S. megaptera* in the shortness of the lateral denticles of the median and inner lateral teeth; moreover all the teeth are stouter and less acute.

The pen resembles that of *Ommastrephes;* it is long, widest anteriorly, bordered by strong ribs, obtusely pointed at the anterior end, gradually narrowing to the very narrow slender portion, about three inches from the posterior end, beyond which there is a thin margin, which expands into a lanceolate form, widest at 1·25 inches from the

end; the terminal portion forms a short, hollow hood, formed by the infolding of the margin, and marked by slender, divergent, raised lines, stronger laterally, and with a dorsal keel. The central rib begins at the anterior end, increases in size to the middle region, then narrows to the slender part, where it forms a slender, prominent rib, only visible dorsally, and then becoming confluent with the lateral ribs, extends as a sharp keel to the end. The lateral ribs commence at about ·75 inch from the anterior end, and each at first consists of three riblets; farther back another appears on the outside margin but is separated only by a slender groove, and toward the slender part of the pen they all coalesce into a single rib on each side, which nearly meet in the middle line ventrally, where they are separated by a slender groove, which disappears farther on. Total length of pen, 349^{mm} (13·75 inches); greatest breadth, 22·5^{mm} (·90 inch); length of posterior cone or hood, ·9^{mm} (·35 inch); breadth of posterior expansion, 15^{mm}.

This specimen was collected at Bermuda, by Mr. G. Brown Goode, and now belongs to the Museum of Wesleyan University, Middletown, Conn. Mr. Goode informs me that it was picked up on the north shore of the island, in December, 1876, and that it was regarded by the inhabitants as a novelty or great rarity, and was noticed as such in the local newspapers.

Histioteuthis D'Orbigny, 1839.

Histioteuthis Férussac & D'Orbigny, Histoire naturelle des Céphalopodes Acétabuliferes, p. 226.

This genus is remarkable for having the six upper, sessile arms united together nearly to their tips by a thin elastic membrane or web. The ventral arms are also united together for a part of their length and their common web is joined to the great web, in the median line, by a bridle-like membrane. The tentacular-arms are very long, and have expanded clubs, with a broad dorsal keel. As in *Architeuthis* and *Sthenoteuthis*, they are furnished with a series of small smooth-rimmed suckers, alternating with tubercles, on the proximal part of the club and adjacent part of the arm, for the purpose of uniting the arms together, at will, but in the following species a row of such suckers and tubercles also extend along one side of the club, opposite part of the large central suckers. The large suckers are serrated, and alternate in two rows; two rows of large marginal suckers exist on one side and two rows of much smaller ones on the other. At the extreme tip of the arm there is a cluster of small smooth-edged suckers, as in *Architeuthis*.

The mouth is surrounded by a broad buccal membrane, with six angles or lobes, but without suckers. The body is relatively short, with short bilobed caudal fins. The eyes are large, and have distinct lids. The dorsal bone or pen is thin, short, lanceolate, and somewhat quill-shaped, with long, lateral expansions.

The species, so far as known, are brilliantly colored, having occellated spots on raised verrucæ, in addition to the ordinary coloration of squids.

The two foreign species, hitherto described, are both from the Mediterranean.

Histioteuthis Collinsii Verrill.

American Journal of Science, vol. xvii, p. 241, March, 1879. Tryon, Manual of Conchology, i, p. 166, 1879 (description copied from the original).

PLATES XXII and XXVI.

A large and handsome species, with the broad, thin, dark brown web, extending between and nearly to the ends of the six upper arms. The outer surface of the head and arms is covered with large, slightly raised warts or tubercles, which are dark blue with a whitish center, specked with brown; three rows extend along the ventral arms and two along the others; a circle of these surrounds the eye-lids, but the edges of the eye-lids are narrowly bordered with dark brown. Color, between the warts, pale purplish brown, with small, raised, dark brown spots, reddish specks, and white granules; web and inner surface of arms uniform dark reddish or purplish brown; suckers yellowish white, their pedicels specked with brown; tentacular-arms light orange-brown. Eyes mutilated; their lids form a large simple, rounded opening.

Tentacular-arms slender, about two feet long and expanding near the end into a broad, long-oval, sucker-bearing portion or 'club,' which is bordered by a membrane, widest on the upper edge; it ends in a tapering tip, on the back of which there is a thin, crest-like membrane or keel, enlarging proximally to its end, where it forms a rounded lobe. The most expanded portion of the 'club' bears six rows of suckers, with finely serrate horny rings; the two central rows contain much the largest suckers, four or five in each; the more central of these two rows contains four suckers, larger than the rest, and of these the two median are largest; outside of these two median rows, are two regular marginal rows of nearly equal, medium-sized, serrate suckers, on the upper edge; and along the lower edge of the club there is one row of few, similar, but smaller ones; outside of these there is an incomplete

alternating row of much smaller marginal ones. On the lower edge of the proximal portion of the club, extending from the middle backward, there is a row of four small, smooth-edged, unequal suckers, alternating with rounded, sessile tubercles that fit into corresponding suckers on the other arm; a row of similar but smaller suckers extends for about six inches along the inner surface in the median line of the arm, alternating at first singly, and then two by two, with tubercles, and gradually becoming more distant. The end of the arm, beyond the expanded club, bears minute serrate suckers, at first in six rows, decreasing to two toward the end. The extreme tip bears a small group of minute, smooth-edged suckers. The largest suckers of the club are decidedly constricted below the margin, and then swell out at the basal portion. The edge of the horny rim is divided into very numerous, small, incurved and crowded denticles, nearly equal in length, but part are thickened and obtuse, while the rest are more slender and acute. Diameter of the largest suckers, 6·5^{mm}; of the largest in the second row, 5·5; of the largest in the lateral rows, 3 to 4; of the largest smooth-rimmed marginal suckers, 2 to 2·5; of the smooth-rimmed suckers of the wrist, 1·5 to 2.

Sessile arms stout, trapezoidal, tapering to slender tips, and bearing two rows of numerous suckers. All the arms on the left side are an inch or more longer than the corresponding right ones. The dorsal and ventral arms, of the same side, are about equal, and decidedly shorter than the two lateral pairs, which differ but little in length. Web about two-thirds as broad as the length of the arms, uniting the upper three pairs together, and as a narrowing border extending along their sides, to the tips. The lower lateral arms have a thin, crest-like membrane on their outer, median surface, commencing at the basal fourth and extending nearly to the tips. The ventral arms are united together, toward the base, by a web, which is also joined to the main web, in the median plane. A narrow outer web, arising from the outer angles of the arms, also unites all the arms together for a short distance above their bases.

The suckers are all similar in form. The larger ones on the dorsal arms are, perhaps, a little larger than those on the lateral and ventral ones. The largest are subglobular, laterally attached, and gibbous; the aperture is small, usually with three or four flat, blunt, or rounded lobes or denticles on the outer margin, with none on the inner margin. The pedicels of the larger suckers are very stout at base, tapering up to their attachment on the lower side of the sucker, where they are small and slender. The largest suckers of the dorsal arms are 5^{mm}

in diameter; their apetures 2^{mm}; length of pedicels 4 to 5^{mm}. The largest suckers on the ventral arms are not so large as those on the others; the largest are 4^{mm} in diameter. Only a few suckers (5 or 6), and these of very small size and nearly in one row, extend below the level of the ventral web, which is attached along the inner margin, inside the row of suckers. The larger ventral suckers are depressed and oblique, with a very one-sided horny ring, which has a small oblique aperture, with about three bluntly rounded, slightly prominent lobes or denticles on the outer margin; while the inner margin is smooth.

The membranes about the mouth are arranged nearly as in *Ommastrephes*. The mouth is surrounded externally by a broad, elevated, smooth, dark chocolate-brown buccal membrane or collar, which is prolonged into six angular lobes, corresponding to all the intervals between the arms, except those between the 2d and 3d pairs; this buccal collar is connected to the interbrachial membrane by six membranous bridles, corresponding to the six lobes; on both sides of the dorsal and ventral bridles are large pouches. The beak is immediately surrounded by a thick, fleshy, lobed and wrinkled collar, and outside of this by another less prominent and less wrinkled one.

The exposed parts of the mandibles are black; the inner laminæ bright reddish brown. The beak of the upper mandible is very acute, strongly incurved, with scarcely any distinct notch at the base of the cutting edge, but with a conspicuously excavated V-shaped area; the anterior edges of the alæ are irregularly and slightly denticulate or crenulate. The lower mandible has a much incurved beak, with the cutting edges decidedly concave, and a very small notch at their bases, but with a broad excavated area along their sides and bases; the anterior edges of the alæ are slightly convex and form a very obtuse angle with the edges of the beak or rostrum; a small, thin tooth exists just beyond the notch; the alæ are broadest near their inner ends; the gular lamina is peculiar in having a prominent, thickened, curved, lateral rib, on each side, running to the end of the prolonged and subacute lateral lobes; and another dorsal one, running to the dorsal emargination. Length of upper mandible, 30^{mm}; height, palatine to frontal, 20; height (or breadth) of palatine 14; tip of beak to end of frontal, 22; to base of cutting edge (notch), 7·5; notch to inner end of alæ (union with palatine), 7·5; beak to posterior lateral border of alæ, 13·5; transverse breadth across outer side of alæ, 9·5. Lower mandible, length, 23^{mm}; inner ends of alæ to mentum, 22·5; tip of beak to dorsal border of gular lamina, 17; to inner ends of alæ, 18; to notch, 8·5; breadth of alæ in middle, 8; greatest

transverse breadth across alæ, 23; across anterior edge, at teeth, 7·5; notch to union of gular lamina and alæ, 6·5; breadth of gular lamina, 12·5.

The odontophore is rather short, the dorsal portion not much exceeding the ventral in length; the lateral membrane is broad and thin, its posterior border extending transversely straight across to the dorsal fold, nearly at right angles to the dorsal portion of the odontophore; the dentigerous portion, including a thickened lateral ridge, outside the teeth, is light red in color. Length of dorsal portion, from anterior bend, 8·5^{mm}; of ventral portion, 8; breadth of dentigerous zone, 3.

The median teeth are short, with a strongly incurved, acute central point, and with small inconspicuous or rudimentary, blunt lateral denticles on each side; the inner lateral teeth are considerably longer, without a distinct lateral denticle; the two outer rows have simple, rather slender, strongly incurved, acute teeth, the outermost a little longer and more slender. The plates along the border appear to be so closely united as not to be easily separated entire; they form a continuous, but slight, narrow ridge, which has an undulated surface. The membrane lining the palate bears pale yellowish, scattered, stout, not very acute, and but slightly curved teeth, with bases not much enlarged; among these are clusters of small, stony, smoothish granules, often aggregated into masses of considerable size. The gular membrane also bears aggregations of small, smoothish, rounded and angular granules, with others that are larger, oblong and oval, smooth, and more or less regularly arranged. The œsophagus is very long and slender, dark-colored.

Measurements of Histioteuthis Collinsii.

	Millimeters.	Inches.
Tentacular-arms, length	609 and 635	24 and 25
Diameter at base	12·5	·50
Breadth of club, without membrane	17·5	·70
Its membranous border	6·2	·25
Length of club	69	2·75
Length of the slender tip	31	1·25
Of dorsal crest	37	1·50
Length of dorsal arm of left side	355	14
Of 1st lateral (2d pair)	432	17
Of 2d lateral (3d pair)	438	17·25
Of ventral	361	14·25
Breadth of lateral arms, at base	22·5	·90
Thickness	19	·75
Diameter of eye-opening	22·5	·90
Diameter of head, at base of arms	87	3·50
Breadth of web, between arms	203 to 254	8 to 10
Diameter of largest suckers of tentacular-arms	6·5	·26

Taken from the stomach of *Alepidosaurus ferox*, lat. 42° 49′, long. 62° 57′, off Nova Scotia, by Capt. J. W. Collins and crew of the schooner "Marion," 1879.

All parts back of the eyes are absent, the eyes are mutilated, but the specimen is otherwise in excellent preservation, even the web and suckers being nearly uninjured.

Observations on some of the more important specimens described from other localities.

We are largely indebted to Professor Steenstrup and to Dr. Harting for our knowledge of the specimens preserved in European museums, or cast ashore on the European coasts. Professor Steenstrup* has given accounts, compiled from contemporary documents, of a specimen taken at Malmö, Sweden, about 1546 or 1549, and of two specimens of huge cephalopods cast ashore at Iceland, in 1639 and Nov. or Dec., 1790.

The specimen of 1790, described in the MSS. of Svend Paulsen, 1792, had tentacles 3 fathoms long; the body (with head) was 3½ fathoms long. That of 1639, described in Olafsens og Povelsens Reise til Island, ii, 716, was 4 to 5 fathoms long.

In the article published in 1857, he also briefly mentioned a specimen cast ashore at Jutland, Dec., 1853, of which the jaws were preserved, and on which he then based the species *Architeuthis monachus;* and another specimen, which he named *Architeuthis dux*, taken by Capt. Vilh. Hygom, in the western Atlantic. He has also since described and figured† the jaws of the specimen of *Architeuthis monachus*, obtained at Jutland, in Dec., 1853.

In the same memoir, of which I have seen only the first part, there are references to a description and figures of '*A. Titan*,' obtained in 1855, by Capt. Hygom, in N. lat. 31°, W. long. 76°. The latter specimen appears to be the same as that referred to in 1856, as *A.*

* Meddelelse om tvende Kiæmpestore Blæksprutter, opdrevne 1639 og 1790 ved Islands Kyst, og om nogle andre nordiske Dyr. Förhandlinger Skandinaviske Naturforskeres, v. pp. 950–957, 1847, Copenhagen, 1849.

Oplysninger om Atlanter colossale Blæksprutter Förhandlinger, Skand. Naturf., 1856, vii, p. 182, Christiania, 1857. Cephalopodum, qui in Museis Hafn. inveniuntur, Kjobenhavn Oversigt., 1861, pp. 69, 165.

† In a paper of which I have seen some proof-sheets, given by him to Dr. Packard, entitled "Spolia Atlantica." This memoir has not been published. The plate (1) that I have seen is marked "Vid. Selsk. Skrifter, V. Række, naturv. og mathem. Afd. iv Bind;" and there are references to three other plates, illustrating '*A. Titan*,' etc.

dux, and the same that Harting* mentioned, under the name '*Architeuthis dux* Steenstrup,' as collected at the same time and place, and of which he published an outline figure (see Plate XXV, fig. 2) of the lower jaw, copied from a drawing furnished to him by Steenstrup.

Harting states that the pen or 'gladius' of this specimen is six feet long. Many important parts of this specimen were secured, and I regret that I have been unable to see the figures and description of it, referred to by Harting as forming part of Professor Steenstrup's unpublished memoir. But to judge by the outline figure given by Harting, it is a species quite distinct from those described by me. The lower jaw resembles that of *A. Harveyi* more than *A. princeps*, and is a little larger than that of our No. 5. The beak is more rounded dorsally, less acute, and scarcely incurved; the notch is narrow, and the alar tooth is not prominent.

M. Paul Gervais, in the Journal de Zoologie, iv, p. 90, 1875, gives a short description of this species, based apparently on the proof-sheets and unpublished plates, not seen by me, of Steenstrup's article, referred to above. He describes it as follows: A large species, of which a fragment of an arm preserved in the Museum of Copenhagen is nearly as large as the arm of a man. The sucker-bearing surface of the arm is extended bilaterally into a membrane exceeding, on each side, the arm itself. Diameter of the opening of the suckers, 0·020; of the suckers themselves, 0·030. Length of the dorsal bone (pen), 2^m; breadth [longueur, by error], measured in the middle of its length [longuenr], 0·17. He refers to Steenstrup's Plates, III and IV.

In a letter to the writer, dated Sept. 4, 1875, Professor Steenstrup states that in addition to the specimens above mentioned, there are, in the Museum of the University of Copenhagen, two complete specimens of *Architeuthis*, preserved in alcohol. Both are of comparatively small size. One, from the northern coast of Iceland,† he refers to *A. monachus*. It has tentacular-arms 10 feet long, and sessile arms 4 feet long. The other is a still smaller one, from the warmer parts of the Atlantic, possibly the young of *A. dux*.

It is evident, therefore, that at no distant day, most of the remaining doubtful points in respect to the structure and relationship of the

* Description de quelques fragments de deux Céphalopodes gigantesques. Publiées par l'Académie Royale des Sciences à Amsterdam. 1860. 4to, with three plates (Verh. K. Akad. Weten., ix, 1861.) The figures have been partly copied in Tryon's Manual of Conchology, i, plates 60 and 86.

† This one is referred to by Dr. Packard, Amer. Naturalist, vol. vii, p. 94, 1873.

species of this genus, can be cleared up by Professor Steenstrup, even if additional specimens should not be obtained.

The publication of Professor Steenstrup's detailed memoir upon this genus would give great pleasure and satisfaction to all students of this class of animals. His thorough knowledge of the group, and his numerous and important investigations of the Cephalopods, published during many years, will give especial value to his conclusions.

Harting, in the important memoir referred to, describes specimens of two species, both of which are apparently distinct from all the Newfoundland specimens enumerated by me.

The first of these (his Plate I) is represented by the jaws and buccal mass, with the lingual dentition, and some detached suckers, preserved in the museum of the University of Utrecht, but from an unknown locality. These parts are well figured and described, and were referred to *Architeuthis dux* by Harting. The form of the lower jaw (see Pl. XXV, fig. 1) is unlike that of *A. dux*, for the beak is very acute, the cutting edge is concave, the notch shallow and broad, and the alar tooth is somewhat prominent. The size is about the same as our No. 5. The suckers (Pl. XXV, fig. 1*a*, 1*b*) are from the sessile arms, and agree pretty nearly with those of *A. Harveyi*. The edge is strengthened by an oblique, strongly denticulated ring, which, in all the suckers figured, including both larger and smaller ones from the short arms, has regular, acute, sub-equal denticles all around the circumference, in this respect agreeing with *A. Harveyi*. The internal diameter of the largest of these suckers is ·75 of an inch; the external, 1·05 inches. They were furnished with slender pedicels, attached obliquely on one side. The lingual teeth (see Plate XVI, fig. 8, copied from Harting) are in seven regular rows, and resemble closely those of *Loligo*. On that account mainly, in a former paper, I proposed to designate it by the name of *Loligo Hartingii*. But since that time I have been able to study the dentition of species of *Architeuthis* and *Sthenoteuthis*, and now refer Harting's species to *Architeuthis* without hesitation, although the dentition is poorly figured. Professor Steenstrup, in a letter to me, subsequent to the publication of my former papers, also expressed the opinion that Harting's specimen belongs to *A. monachus*. If distinct, however, as is possible, it may be called *Architeuthis Hartingii*.

The other species described by Harting was from the Indian Ocean, and belongs to the genus *Enoploteuthis*.

In this genus there are large, sharp, curved claws (Pl. XXV, figs. 4, 4*a*), both on the club of the tentacular-arms and on the sessile arms,

in place of the suckers of ordinary squids. The teeth of the odontophore, in Harting's species, are remarkably small and simple (see fig. 4, *b*), after Harting. As this species does not appear to have had a special name, I propose to call it *Enoploteuthis Hartingii.*

D'Orbigny* gave the name *Enoploteuthis Molinæ* to a large species, of which the body was estimated to be about 4 feet long, found floating and mutilated in the South Pacific, S. lat., 30° 44′; W. long. 110° 33′, by Banks and Solander, in 1769, on Capt. Cook's second voyage. Of this, fragments are preserved in the Museum of the College of Surgeons, London.†

A similar species, perhaps identical, had previously been recorded by Molina, from the coast of Chili, as *Sepia unguiculata.*

According to Jeffrey's British Conchology, vol. v, p. 124, a huge Cephalopod was stranded in 1860 or 1861, between Hillswick and Scalloway, on the west of Shetland. "From a communication received by Professor Allman it appears that the tentacles were 16 feet long, the pedal-arms about half that length, and the mantle sac, 7 feet; the mantle was terminated by fins; one of the suckers examined by Professor Allman was $\frac{3}{4}$ inch in diameter."

Mr. Kent, in the articles already referred to,‡ mentions a sessile arm of a giant cephalopod, which has been long preserved in the British Museum, but of which the origin is unknown. He states, in the first article, that it is just 9 feet long and 11 inches in circumference at the base, tapering off to a fine point. There are about 150 suckers, in each of the two alternating rows, those at the base being ·75 of an inch in diameter.

In his second article he refers this arm doubtfully to *Ommastrephes todarus*, and gives the following description:

"The length of this arm, from one extremity to the other, is just 9 feet; the circumference at the base 11 inches; and from this it gradually decreases, terminating in a fine point. The suckers are arranged in two rows throughout the extent of the arm, numbering, approximately, 150 to each row, or a total of 300 to the whole organ. Forty-three suckers only are stationed on each side in the first or proximal half of the arm; one hundred on each side occupy the whole length, with the exception of 14 inches, this smaller length including the remaining fifty on each side, which are very minute and crowded

* Histoire Nat. des Céphalopodes Acétabuliferes, p. 339, 1845.

† See also Todd's Cyclopedia of Anatomy and Physiology, i, p. 529.

‡ Proceedings Zoological Society of London for 1874, pp. 178 and 493.

together. The comparative distances between the suckers throughout the whole length in each row are as follows:—between the first and second sucker, 1½ inch; halfway up the arm, 1 inch; at three quarters of the entire length, ½ inch; and within six inches of the distal extremity, ¼ inch. The relative diameters of the suckers at similar distances are:—at the base, extreme outside measurement ¾ inch, inside measurement of corneous ring ½ inch; and, those suckers a little past the first few being the largest, halfway down ½ inch outside and ½ inch inside measurement, at three quarters length ¼ inch, and at 6 inches from the extreme point ⅛ inch outside measurement, gradually diminishing from here to the size of a pin's head.

The shape and structure of the suckers upon this British-Museum specimen agree with those of *Ommastrephes todarus* as given by D'Orbigny, corresponding also with those figured by Harting, referred by him to the same species, and anticipated by the same authority to be also identical with Prof. Steenstrup's *Architeuthis dux*. More minutely they may be described as hemispherical in shape, the stalk or peduncle being attached laterally at the base of the hemisphere, the point of insertion of the same in the cup being marked by a conspicuous pit-like depression. The horny ring is obliquely set, and much deeper at the side opposite the insertion of the stalk; the inner margin is serrated; and in most examples the serratures bordering the deeper side are considerably larger than in the other portions of the circumference; in some instances the serratures, except at the particular point mentioned, are altogether aborted, having the inner margin of the ring quite smooth; in other examples, and more especially among the larger suckers, the teeth or serratures are equal or subequal. The average number of the teeth of the largest rings is twenty."

Mr. Kent, unfortunately, does not state to which pair this arm belongs. But from his description, it is, perhaps, a ventral arm. It evidently belongs to an *Architeuthis*, and is very near to our *A. princeps*.

Lieut. Bouyer, of the French steamer 'Alécton,' encountered a huge cephalopod, in November, 1860, between Madeira and Teneriffe. Its body was estimated to be between 15 and 18 feet in length. A long and laborious attempt was made to capture it, and a slipnoose was passed around the body, but on attempting to hoist it on board the rope cut through the soft flesh and the tail alone was secured. A sketch of the animal was made by one of the officers, and Messrs. Crosse and Fischer* have, from this figure and the narrative of the

* Journal de Conchyliologie, 3d ser., vol. ii, p. 138, 1862. See also Tryon's Manual of Conchology, vol. i. p. 87, Plate 59, 1879 (figure copied from the original).

officers,* proposed to establish a species for this specimen, which they named *Loligo Bouyeri.* The figure is very imperfect, but evidently represents a ten-armed cuttle-fish, though only eight arms are shown, and the tail is represented as truncated. In fact, there is nothing about the figure or description sufficient to indicate specific, or exact *generic* characters. The eight short arms, shown in the figure, are stout, tapered, and less than half the length of the head and body together. It was more probably a species of *Architeuthis*, to judge from the caudal fin, described as consisting of two rounded lobes, of small size. It may be designated as *A. Bouyeri*, provisionally.

In the Journal de Zoologie, vol. iv, No. 2, p. 88, 1875, M. Paul Gervais has given a partial summary of the gigantic Cephalopods previously known, and has mentioned an additional species (*Architeuthis Mouchezi* Vélain), of which portions were brought to Paris by M. Vélain, from the Island of St. Paul, Indian Ocean, where it was cast ashore in November. He also quotes the brief notice of the animal by M. Vélain (in Comptes Rendus, t. lxxx, p. 1062, Seance du April 19, 1875). It is stated that this example belongs to the same group with *Ommastrephes.* A description and a rude figure of it, made from a photograph taken in the position in which it lay upon the shore, has also been published by M. Vélain in the Arch. de Zool. Exper., vol. vi, p. 83, 1877. The figure has been copied in Tryon's Manual of Conchology, vol. i, Pl. 82. According to this figure the tentacular-arms were very long and the short arms were truncated, probably owing to mutilation. One of the tentacular-arms was saved, and, with the beak, is preserved in Paris. The caudal fin was narrow and lanceolate, adhering to the sides of the body by its entire length. In the latter feature this is very different from any of the northern species.†

In the Archives de Zool. Experimentale, vol. vi, 1877, M. Vélain has proposed a new genus (*Mouchezia*) for this specimen. The peculiarity of the pen appears to be the only character, of any importance, referred to by him.

In The Zoologist, London, 2d Series, No. 118, p. 4526, July, 1875, there is an article entitled, "Notice of a gigantic Cephalopod (*Dinoteuthis proboscideus*), which was stranded at Dingle, in Kerry, two hundred years ago. By A. G. More, F.L.S." The article is chiefly a reprint of the rude, but interesting, popular accounts written at the time of the capture, and upon these Mr. More attempted to found a new genus and species. The character which he mainly relied upon,

* See Comptes Rendus, Acad. Sci., vol. 53, pp. 1263–7, 1861.

† See also Tryon's Manual of Conchology, i, pp. 89 and 184, 1879.

as of generic value, is the power of projecting the beak in the form of a proboscis. But this is habitually done by the various common species of *Ommastrephes*, *Loligo*, etc., and perhaps by all ten-armed cephalopods. There is not sufficient evidence, from the published accounts, that this specimen differed in any way from the *Architeuthis monachus*. It was described as 19 feet in total length; the long arms having been mutilated, the part remaining was 11 feet long, and as thick as a man's arm; the short arms varied from 6 to 8 feet in length, and were as thick as a man's leg, and had two rows of large serrated suckers; the proboscis (buccal mass with beak) was the size of a man's fist; the beak was "somewhat like to an Eagle's Bill, but broader." The whole animal was said to have been as large as a large horse. The length of the head and body together was 8 feet.

Mr. More has kindly sent me a tracing from the original figure. This shows a broad, oval, flat body, and a small caudal fin. The body or mantle had evidently been split open and spread out flat.

This fact is also evident from the original descriptions reprinted by Mr. More, in which the sides of the mantle are described as follows: "Over this Monster's back was a mantle of a bright Red Color, with a fringe round it, it hung down on both sides like a Carpet on a table, falling back on each side, and faced with white." The liver, according to the descriptions, had been removed: "When it was dead and opened the liver wayed 30 pound." The proboscis had also been removed before it was exhibited, and it is therefore very probable that the figure and descriptions represent it as more extended than was natural.

The measurements given indicate a specimen smaller than several of the American examples, and but little, if any, larger than our No. 5, from Logie Bay.

In the Zoologist, June, 1875, p. 4502, and August, p. 4569, and in the August number of the Annals and Magazine of Natural History, vol. xvi, p. 123, the same writer gave an account of the capture, and briefly described the beak, odontophore, and portions of the tentacles and arms of another specimen, taken off Boffin Island, on the west coast of Ireland, April, 1875. The tentacular-arms are said to have been 30 feet long; the expanded portion 2 feet 9 inches; the large central suckers nearly 1 inch in diameter; those of the outer rows ·5 of an inch; one short arm is said to have been 8 feet long, and 15 inches in circumference at the base, when fresh. It had small suckers without teeth on the horny rings, on the 'wrist' of the 'club' and

scattered along the tentacular-arms, as do our specimens. The rounded tubercles that always accompany these smooth-rimmed suckers are not mentioned, but doubtless they were also present. The beak was 5·25 inches long and 3·5 broad, dark reddish brown, "with a large tooth in both margins of the inner mandible and a much smaller notch on each side of the outer mandible."

Mr. More believed this to be distinct from the Newfoundland species and referred it to *A. dux*, but his description agrees closely with the corresponding parts of *A. Harveyi* (No. 5) described by me, except in the relatively somewhat greater size of the sessile arms at base. In this respect, however, it is equalled or surpassed by our No. 14, and by others of the Newfoundland examples. This may also be only a peculiarity of the female. The measurements indicate a specimen intermediate in size between our Nos. 5 and 14, but the description is not sufficient to indicate with certainty to which of our species it was nearest related. A more detailed description, with figures of the suckers and odontophore, would probably settle this point. Mr. More supposed that the lateral suckers of the tentacular-club were larger in his example than in *A. Harveyi*, but that is not the case.

A large cephalopod, referred doubtfully to *Ommastrephes*, has been recorded from Japan and described by Dr. F. Hilgendorf.* It was taken on the east coast of Japan, N. lat. 35° to 36.° It had been split open, salted, and partly dried, and the viscera had been removed. The ends or clubs of the tentacles were also gone. In this condition it was on exhibition in Yedo. The following are the measurements given: Tip of tail to front edge of mantle, 186^{cm} (6 feet, 1 inch); mantle to mouth, about 41^{cm} (1 foot, 5 inches); longer sessile arms, 197^{cm} (6·5 feet); from tip of tail to tip of sessile arms, 414^{cm}; total expanse across outstretched tentacles, 660^{cm}; circumference of mantle (breadth as cut open), 130^{cm}; length of caudal fin, 60^{cm}; breadth of caudal fin in middle, 45^{cm}; breadth of forward end of caudal fin, 28^{cm}; diameter of posterior tip, 1^{cm}; tongue of funnel, 10^{cm} broad, 6^{cm} long; eye-opening, which was oblong-oval, without an obvious sinus, 19^{cm}; distance between eyes, 26^{cm}; diameter of oval skin of lip, 12^{cm} by 8^{cm}; breadth of sessile arms, 11^{cm}; of tentacles, 2 to 3^{cm}; diameter of horny rings of suckers, on base, 1·5^{cm}; height, 0·7^{mm}; number of denticles, 37.

* Mittheilungen der deutschen Gesellschaft für Natur und Völkerkunde Ostasiens. Herausgegeben von dem Vorstande, 1st Heft, p. 21, May, 1873, Yokohama, Japan. See also American Journal of Science, vi, p. 237, Sept., 1873.

The following species, although the specimens, when found, had lost some of their most characteristic parts, appears to be nearly related to *Onychoteuthis*, a genus having sharp claws instead of suckers on the 'club' of the tentacular-arms, and a cluster of small tubercles and smooth suckers on its 'wrist,' to unite the arms together. It probably belongs to the group *Lestoteuthis*, characterized below.

Onychoteuthis robusta (Dall).

Ommastrephes robustus (Dall, MSS.) Verrill, American Journal Science, vol. xii, p. 236, 1876.

Plates XXIII and XXIV.

This large and very interesting species* was discovered by Mr. W. H. Dall, near Iliuliuk, Unalashka I., off the coast of Alaska.† He found three specimens thrown upon the beach, April 26 and May 8, 1872. He made descriptions, measurements, and some very valuable drawings of them, while fresh. The specimens had all been more or less mutilated by the ravens before they were discovered. He preserved the pharynx, beak, and odontophore of No. 1; part of the 'bone,' a piece of the caudal fin, and the basal part of one of the ventral arms, with five of the suckers adhering, from one of the other specimens, (No. 2), and has generously placed them in my hands for examination, together with his drawings, measurements and notes.

The parts remaining of the largest specimen, No. 3, when found had a total length of 427^{cm} (14 feet), but the ends of the tentacular-arms had been destroyed; length from tail to base of tentacular-arms, 559^{cm} (8 feet, 6 inches); to front edge of mantle, 232·4^{cm} (7 feet, 7½ inches); width across fins, 107^{cm} (42 inches); diameter of body, 45·7^{cm} (18 inches); slender basal portion remaining of tentacular-arms, 155^{cm} (61 inches); their diameter, 6·3^{cm} (2·5 inches); short arms (ends gone), 76 to 102^{cm} (30 to 40 inches); length of pen, 226^{cm} (7 feet, 5 inches).

According to Mr. Dall's notes the color was reddish, in fine red dots on a whitish ground, with a darker stripe on the outer median line of the arms. The eyes were bluish-black, furnished with lids, and with a small sinus in front; diameter of the opening, 2·5^{cm} (1 inch).

The mandibles retracted into a short, yellow, puckered muzzle, which was included in a longer, plain, proboscis-like tube, extending an inch or two beyond. Siphon, short and thick.‡ Region of the eye

* This is the species referred to as perhaps *Onychoteuthis Bergi* by Mr. Dall in his note upon large cephalopods, in the American Naturalist, vol. vii, p. 484, 1873.

† The first specimen was found by Mr. M. W. Harrington, of Mr. Dall's party, on the west shore of Amaknak Island, Captain's Harbor, Unalashka, April 26th.

‡ No valve is shown in Mr. Dall's sketches.

somewhat raised. The nuchal collar is well-marked, and slightly above it, on each side, is a raised epidermal ridge, from which three wavy, raised bands or frills, attached at their inner edge, pass obliquely backward, on each side. No cranial cartilage was observed. Mantle firm and dense. The neck has one median dorsal and two ventral facets, long, oval-shaped, with a median depressed line, but otherwise smooth and white; the dorsal moves on a smooth part of the inside of the mantle; the ventrals move on similar raised facets of the mantle beneath. The caudal fin was rather broad, lanceolate or spear-shaped, acute at tip. Gills yellowish olive, with obliquely transverse laminæ. Gizzard, yellowish, the muscles laid like a coil of spun-yarn, in layers transverse to one another.

The pen, (Pl. XXIII, figs. 4, 5,) was gone from the first specimen (No. 1) and broken in the others. It was found unattached, in the dorsal cavity. It had a thickened median rib, but becomes very thin at the sides, and is divided by sharp, stiff ribs or folds into three longitudinal areas, on each side (Pl. XXIII, fig. 6). The posterior end is one-sided, funnel-shaped close to the tip, which is inserted into a long, round, thick, firm, cartilaginous cone, which tapers to a point posteriorly. The portion of the pen (of No. 2) preserved* and forwarded to me, includes all the cone and a part of the posterior end of the quill-portion, attached within the concavity of the cone (Pl. XXIV, fig. 7). The anterior end of the cone is concave and very obliquely terminated, the dorsal side extending forward some distance along the dorsal side of the quill. The whole length of the preserved cone, (doubtless much shrunken by the alcohol) is 44·5^{cm} (17·5 inches); of the oblique anterior termination, 15·25^{cm} (6 inches); greatest diameter, 4^{cm} (1·6 inches). The cone is nearly round, firm, translucent, brownish, or deep amber-color, and composed of numerous distinct concentric layers. The concavity of the anterior end firmly embraces the remnant of the funnel of the quill, which has numerous small costæ converging to the apex; two of the dorsal costæ are much stronger than the rest, forming a strong ridge each side of the smaller median costa, which lies in a deep median depression or furrow.

The tentacular-arms had lost their clubs; but the part remaining was cylindrical, 2·5 inches in diameter. The other arms were some-

* Mr. Dall states that he attempted to dry the rest of this pen, and that of No. 3, but they turned brown, and then black, effloresced, and decomposed. He also states that the pen, when fresh, was translucent whitish, and that it changed to brownish yellow in the alcohol.

what thicker. The few suckers remaining on them, were attached by slender pedicels, and arranged in two alternating rows; they were furnished with horny rims having the edge entire, except where irregularly broken away; those of the distal part of the arms were gone.

The portion of the arm of the second specimen, preserved in alcohol and sent to me, came from the base of the left ventral arm. It is 65^{mm} in length: diameter, from inner to outer surface, not including marginal membrane, 45^{mm}; including membrane, 64^{mm}. It is well rounded on the inner face, but more flattened on the upper side, while the outer surface is broadly rounded; the outer angle has a strong, thick, marginal membrane, 19^{mm} wide (see section of this arm, Plate XXIV, fig. 8, *c*). The sucker-bearing surface is broad, with a slight marginal membrane along each margin (*b*, *b*^{1}) rising into broad, flat, somewhat thickened blunt lobes alternating with the suckers. Two alternating rows of firm, smooth, rather irregular-shaped tubercles, run along the median region, between the rows of suckers, with which they alternate, on each side.

This segment of the arm still bears five suckers, which appear to represent the 1st, 2d, and 4th pairs, though there may possibly have been others before the first of these. They are all similar, rather small in proportion to the arm, round, but little oblique, decidedly convex beneath, and with a rather long, slender pedicel, (fig. 8, *a*). The horny marginal rings are dark brown, yellowish at the thin edge, which is entire and nearly smooth, except where broken. The largest of these remaining suckers are 8·5^{mm} in diameter, outside; aperture, 5^{mm}; height of cup, 7^{mm}; length of pedicel, 3^{mm}.

The exposed parts of the jaws are black and polished; their internal laminæ are reddish brown, becoming translucent yellowish toward the margins.

The upper mandible (Plate XXIV, fig. 5), has an elongated, tapered, considerably incurved and sharp rostrum; the notch is rather narrow and deep, and a well-developed, triangular, lateral groove runs down from the notch for some distance, its upper border being in line with the cutting edge of the rostrum. The anterior edge of the alæ, so far as normally exposed, is nearly straight, but slightly undulated.

The lower mandible (Plate XXIV, fig. 6), has the cutting edges of the rostrum slightly concave, with a slight notch close to the tip, which is small and incurved; the notch at the base is broad and shallow, bordered externally by a slight, angulated ridge; the exposed anterior edges of the alæ have, each, two slight lobes, but are otherwise nearly straight; the alæ are broader toward the inner end, which is obtusely rounded.

The lower mandible now measures, from the tip of the rostrum to the posterior dorsal border of the mentum, 13mm; tip to the extreme posterior end of the gular lamina, 50mm; to the dorsal angle of the same, 33mm; tip to the inner end of the alæ, 46mm; to the bottom of the notch, 13mm; breadth of alæ, 24mm; transverse breadth at notches, 12mm.

The upper mandible, from the tip of the beak to the end of the palatine lamina, is 71mm long; from tip of beak to end of frontal lamina, 53mm; to bottom of notch, 11mm; length of exposed (dark) portion of anterior edge of alæ, 14mm.

The odontophore (Plate XXIV, figs. 1–4), has a very broad, thin, marginal membrane, yellowish-white in color, becoming brown and thickened toward the dentigerous portion, where there is a row of very small, thin plates, bordering the outer row of teeth; the ventral portion of the dentigerous band is dark brown, regularly convex, and narrowed gradually to the obtuse end; the dorsal portion is considerably longer, abruptly bent backward, with the borders incurved, gradually decreasing to the posterior end; on this part the teeth become much smaller and paler.

The outer lateral teeth, on the anterior portion, are long, slender, sharp, and strongly curved; the median ones are much shorter, with a sharp, strongly curved central point and a very small, almost rudimentary denticle on each side; the inner laterals are a little longer than the median, with a stout incurved point; on the outer side of its base there is a small denticle; the teeth of the two outer rows, on each side, are simple.

Length of odontophore, from anterior bend to posterior tip of dorsal end, 22mm; to tip of ventral end, 14mm; breadth of lateral membrane, in middle, 11mm; of dentigerous belt, anteriorly, 3mm.

The following measurements were made by Mr. Dall, from the fresh specimens.

Table of measurements (in inches).

	No. 1.	No. 2.	No. 3.
Total length (to mutilated ends of tentacles),	80+	110+	167+
Base of arms to tip of tail (head and body),	51	67	102
Base of arms to edge of mantle (head),	5	6	10·5
Edge of mantle to tip of tail (body),	46	61	91·5
Length of tail-fins (insertion to tip),	--	33·75	48
Breadth of tail-fins,	13·5+	25·5	42
Length of 'pen,'	--	60	89
Breadth of pen, in middle,	--	--	12·25
Length of tentacular-arms (ends gone),	30+	43+	61+
Length of longest sessile arms (ends gone),	30+	23·5+	40+
Diameter of body,	7·5	--	18
Breadth between insertions of fins,	--	3·5	5
Diameter of eye,	--	1	1·25

The generic affinities of this species must be regarded as still somewhat doubtful, owing to the absence of the tentacular-clubs, and most of the suckers of the sessile arms. The characters of the 'pen;' of the dentition, especially of the median teeth; of the nuchal frills; of the siphon; and of the cartilaginous facets of the neck, all indicate that it belongs in the family *Onychoteuthidæ*, near *Onychoteuthis*. But in this family there is great diversity as to the arrangement of the hooks and suckers, constituting the armature of the arms. Some of these combinations are as follows:

Sessile arms with suckers only.

Onychia.—Tentacular-club with two central rows of hooks, rows of small suckers along each margin, and a cluster of suckers and tubercles on the 'wrist.' Sessile arms with smooth suckers.

Onychoteuthis (typical).—Tentacular-club with two rows of hooks, with an apical cluster of suckers, and with a cluster of suckers and tubercles on the wrist. Sessile arms with suckers in two rows.

Ancistroteuthis (typical).—Two central rows of hooks, with proximal and apical suckers on the club, as in the last. Pen with a long, terminal, cartilaginous cone.

Ancistroteuthis Krohnii.—Tentacular-club with one row of suckers and one of hooks in the middle portion.

Dosidicus.—Tentacular-club with hooks. Sessile arms with large suckers on the proximal portion and small ones on the distal. Pen with a solid cone.

Sessile arms with both suckers and hooks.

Gonatus.—Tentacular-club with one or two central hooks proximally, and with numerous, multiserial, small suckers, distally. Sessile arms with four rows of suckers, those of the two central rows with a median hook, the outer ones serrate.

Abralia.—Tentacular-club with two rows of alternating hooks and suckers, in the middle, and with clusters of suckers on the wrist and apex. Sessile arms with hooks on the basal portion, and suckers toward the tips.

Lestoteuthis (gen. nov.).—Tentacular-club with numerous suckers, and few large central hooks. Sessile arms dissimilar; lower ones with four rows of suckers; upper with two central rows of hooks, and with marginal suckers on each side. Pen with a long terminal cone. (Type *A. Kamschatica* Middendorff, sp.)

Sessile arms with hooks only.

Verania.—Tentacular-club with suckers only; sessile arms with hooks only.

Acanthoteuthis.—Tentacular and sessile arms with hooks (fossil).

Ancistrocheirus.—Tentacular and sessile arms with hooks in two rows. Pen dilated at both ends.

Enoploteuthis (typical).—Tentacular-club with two rows of hooks, and with a cluster of small suckers on the wrist. Sessile arms all with hooks in two rows, extending to the tips.

It will be evident from these characters, that Mr. Dall's species, having two rows of smooth suckers, at least on the basal portion of the ventral arms, can belong to none of these genera, except those in the first group and *Lestoteuthis* in the second. Of these, *Gonatus* would be excluded from consideration by its different pen and four rows of suckers; *Onychia* and typical *Onychoteuthis* by the form of the pen. After this elimination we still find three generic groups to either of which it might belong, so far as its armature is known, viz: *Ancistroteuthis*, *Dosidicus*, and *Lestoteuthis*. The first of these is, perhaps, nothing more than a sub-genus of *Onychoteuthis*, the principal difference being in the pen, which is somewhat pennate and lanceolate in the typical species of the latter, but nearly linear with a solid cartilaginous terminal cone in the former. In this last character, and in the general form of the pen, *O. robusta* somewhat approaches *A. Lichtensteinii*. But *Dosidicus* and *Lestoteuthis* also have a solid cartilaginous cone, and the latter, especially, agrees most closely in the general form of the body and caudal fin; and its pen has very nearly the form and structure seen in *O. robusta*.

So far as we can judge, therefore, with our present imperfect data, the relationship of *O. robusta* appears to be rather with *Lestoteuthis* than with any other known group. It is possible, however, that its affinities may prove to be closer to *Ancistroteuthis*, when the armature is discovered.

Lestoteuthis, gen. nov.

The characters of *Lestoteuthis Kamschatica*, which I propose to take as the type of this generic group, are not yet fully known. The peculiarities in the armature, both of the sessile and tentacular-arms, as given above (p. 250) are quite sufficient, however, to warrant its separation from all the other genera. Its pen, as figured, also differs from all others, hitherto described. It is narrowest anteriorly, gradually and slightly expanding backward to the one-sided conical

hood or cone, which appears to be inserted into a solid terminal cone, much as in *L. robusta*, but the cone is relatively shorter. The caudal fin is large, rhomboidal, and acute posteriorly, as in the latter. The tentacular-club bears two large, abruptly curved, claw-like hooks in the middle, with numerous small suckers around them, and on the proximal part. The length of the head and body of the original example was about 28^{cm} (11 inches).

Mr. Dall has described a small species (probably young) from the coast of California, which may possibly belong to the same group. He referred it doubtfully to *Onychoteuthis* (*O. lobipennis* Dall).

Professor G. O. Sars, in his recent work (Mollusca Reg. Arct. Norvegiæ, p. 377), also mentions a specimen of *Architeuthis* (12 feet long), cast ashore on the Norwegian coast, at Foldenfjord, in 1874. He refers it doubtfully to "*A. dux* Steenstrup," (from the Kattegat) by which we should understand *A. monachus*, without doubt.

Note on Large Species of Octopus.

Although this article relates specially to the gigantic species of ten-armed Cephalopods, it may not be amiss to add a few lines in respect to species of *Octopus*, that attain large dimensions. It is certain, however, that none of the latter that have hitherto been examined by naturalists reach dimensions to be compared with those of the species of *Architeuthis*, *Onychoteuthis* (or *Lestoteuthis*) *robusta* and their allies.

The common *Octopus* of the west coast of North America (*O. punctatus* Gabb) is one of the largest of its tribe, hitherto studied. According to Mr. W. H. Dall,* it occurs abundantly at Sitka, and there "reaches a length of sixteen feet or a radial spread of nearly twenty-eight feet, but the whole mass is much smaller than that of the decapodous cephalopods of lesser length. In the Octopus above mentioned, the body would not exceed six inches in diameter and a foot in length, and the arms attain an extreme tenuity toward their tips." Dr. W. O. Ayres tells me that he has often seen this species exposed for sale in the markets of San Francisco (where it is eaten chiefly by the French), and that specimens with the arms 6 or 7 feet long are common. A smaller specimen, presented to the museum of Yale College, was over 4 feet long, and weighed 14½ pounds.

Prof. W. H. Brewer states that he has seen specimens in the San Francisco markets which spread fourteen feet across the outstretched arms.

* American Naturalist, vii, p. 485, 1873.

The common *Octopus vulgaris* ("poulpe" or "devil-fish") of the Mediterranean, sometimes grows to a somewhat formidable size. According to Verany, the largest one seen by him was 9 feet long and weighed 25 kilogrammes (Tryon). This one was captured by a fisherman, with his hands only.

A large species, perhaps the same, occurs in the West Indies. According to Professor B. G. Wilder,* a correspondent, Mr. J. S. George, of Nassau, N. P., mentions, in a letter, the occurrence there of an *Octopus* "ten feet long, each arm measuring five feet; the weight was estimated at between two hundred and three hundred pounds." It was found dead on the beach.

Specimens of similar size have been recorded from other parts of the world, while more or less fabulous accounts of more gigantic forms are numerous, especially among the early writers. But at present it seems most probable that the large fragments recorded as being frequently vomited by wounded sperm whales, belong to species allied to *Architeuthis*, though such fragments have often been referred to *Octopus*.

There is no satisfactory evidence that any of these species of *Octopus* ever intentionally attack man, or that any one has ever been seriously injured by them. They are rather sluggish and timid creatures, seeking shelter in holes and crevices among rocks. They feed mainly upon bivalve mollusks, but will also eat fish, and might, perhaps, like lobsters and crabs, devour dead bodies. Their power and ferocity, as well as their size, have often been excessively exaggerated.

ERRATA.

Page 190, line 32, for 2·5, read 3·5.
Page 193, line 11, for 1878, read 1879.

* American Naturalist, vol. vi, p. 772, 1872.

EXPLANATION OF THE PLATES.

Plate XIII.

Figure 1.—*Architeuthis Harveyi* (No. 5). Head and arms, $\frac{1}{9}$ natural size, from a photograph of the specimen when freshly caught. The back of the head rests upon an oar so as to cause the beak to protrude, while the arms hang down in a reversed position. The diameter of the bathing tub was 38·5 inches: *a*, left, and *a′* right ventral arms; *b*, left, and *b′* right arms of the third pair; *c*, left, and *c′*, right arms of the second pair; *d′*, right dorsal arm, mostly concealed behind the others; *e*, left and *e′*, right tentacular-arms, folded several times over the oar; *i* to *iv*, the 'club'; *i* to *ii*, the 'wrist'; *ii* to *iii*, the part bearing large suckers; *iii* to *iv*, the terminal division; *o*, the beak.

Figure 2.—Part of the body and caudal fin of the same specimen, $\frac{1}{9}$ natural size, from a photograph made at the same time with the preceding; *u*, mantle cut open; *t*, tip of tail; *b*, right and *l*, left lateral lobes of caudal fin.

Plate XIV.

Figure 1.—*Architeuthis Harveyi*. A restoration, $\frac{1}{22}$ natural size, based on the preceding figures and on the specimens received. (See note, p. 184).

Plate XV.

Figure 1.—*Architeuthis Harveyi* (No. 5). Upper mandible, natural size.

Figure 2.—Lower mandible of same, natural size; lacks a small piece at *a*.

Figure 3.—Anterior part of the 'pen' of the same specimen, $\frac{1}{5}$ natural size. The dotted lines indicate missing parts. (Restored and drawn by the author).

Figures 1 and 2 were drawn by Mr. J. H. Blake, from alcoholic specimens.

Plate XVI.

Figure 1.—*A. Harveyi* (No. 5). Portion of the lining membrane of the palate, enlarged.

Figure 2.—*A. Harveyi* (No. 5). Caudal fin, $\frac{1}{10}$ natural size, drawn from the preserved specimen.

Figure 3.—*A. Harveyi* (No. 5). Suckers of tentacular-arm, natural size; *a*, one of the largest suckers; *b*, one of the marginal suckers.

Figure 4.—The same. Horny marginal ring of one of the suckers from a sessile arm, enlarged 2 diameters.

Figure 5.—*A. Harveyi* (No. 4). One of the larger suckers from the tentacular-arms, natural size. From a dried specimen.

Figure 6.—Portion of the marginal ring of the same sucker, enlarged.

Figure 7.—*Loligo pallida* V. Part of odontophore, much enlarged.

Figure 8.—*Architeuthis Hartingii* V. Part of odontophore, enlarged. Copied from Harting's figures.

Figures 5 and 6 were drawn by J. H. Emerton; the rest by the author.

Plate XVI*a*.

Figure 1.—*Architeuthis Harveyi* V. (No. 5). Teeth of the odontophore, from the anterior portion, enlarged 18 diameters; *a*, median; *b*, inner lateral; *c*, and *d*, the two outer lateral teeth; *e*, marginal plates.

Figure 2.—The same. Teeth from the same specimen, from farther back, on the dorsal portion of the odontophore. Lettering as in figure 1.

Figure 3.—The same. Anterior portion of odontophore, showing the teeth nearly in their natural positions, enlarged.

Figure 4.—The same. Portion of the membrane lining the palate, showing teeth and hard granules, enlarged.

Figure 5.—The same. Two of the granules from the membrane lining the mouth, enlarged 18 diameters.

Figures 6 and 6ª.—The same. One of the largest and least oblique of the horny rings from the suckers of the sessile arms; top and side-views, enlarged 1½ diameters.

Figures 7 and 7ª.—The same. One of the medium sized, and more oblique suckers of the sessile arms; top and side-views, enlarged 1½ diameters.

Figure 8.—The same. Another similar sucker, but smaller and more oblique; top-view, enlarged 1½ diameters.

Figures 9 and 9*a*.—The same. One of the horny rings from one of the smooth-rimmed suckers on the 'wrist' of the 'club' of the tentacular-arms; top and side-views, enlarged 3 diameters.

Figures 10 and 10*a*.—The same. One of the small suckers from the terminal portion of the 'club,' top and side-views, enlarged 3 diameters.

Figures 1 to 5, and 8, are camera-drawings by the author. The others are by J. H. Emerton.

Plate XVII.

Figures 1 and 1ª.—*Architeuthis princeps* Verrill (No. 14). A marginal ring from one of the large suckers of the tentacular-arm; 1, side-view, enlarged 1½ diameters; 1ª, portion of the rim, enlarged 3 diameters.

Figures 2 and 2ª.—The same. One of the medium-sized oblique sucker-rims from a sessile arm, enlarged 1½ diameters; top and side-views.

Figures 3 and 4.—The same. Top and side-views of one of the smaller sucker-rims from a sessile arm, enlarged 3 diameters.

Figures 5 and 6.—The same. Top and side-views of a complete sucker, with its pedicel, from a sessile arm, enlarged 1½ diameters.

Figure 7.—The same. Top-view of one of the smaller, very oblique sucker-rims from a sessile arm, enlarged 3 diameters.

Figure 8.—The same. Portion of the horny rim of a medium-sized sucker from a sessile arm; top-view, enlarged 6 diameters, from a camera-drawing.

Figure 9.—The same. Side-view of the horny ring of one of the largest and least oblique of the suckers of the sessile arms, enlarged 1½ diameters.

Figure 10.—The same. Side-view of the horny ring of one of the marginal suckers of the tentacular-club, enlarged 3 diameters.

Figure 11.—*A. princeps* (No. 13). Portions of the horny ring of one of the large suckers of the tentacular-arm, much enlarged; *a* and *b*, portions of the margin, from the outside; *c*, portion seen from the inside.

Figures 8 and 11 are camera-drawings by the author; all the others are by J. H. Emerton.

PLATE XVIII.

Figure 1.—*Architeuthis princeps* V. (No. 10). Upper jaw, natural size.

Figure 2.—The same. Lower jaw; the dotted line shows the parts that are present on the opposite side.

Figure 3.—*Architeuthis princeps* (No. 1). Part of lower jaw, natural size.

Figures 1 and 2 were drawn by the author; figure 3 by J. H. Emerton.

PLATE XIX.

Figure 1.—*Architeuthis princeps* V. (No. 14). Caudal fin from beneath; from the specimen a few days after it had been placed in alcohol.

Figure 2.—The same specimen, after it had been preserved several months in strong alcohol.

Figure 1 was drawn by J. B. Holder, M.D.; figure 2. by the author.

PLATE XX.

Architeuthis princeps V. (No. 14). General figure; from the recently preserved specimen; restored, in part, in accordance with the measurements of the freshly caught specimen; $\frac{1}{15}$ natural size. Drawn by the author.

PLATE XXI.

Figure 1.—*Sthenoteuthis megaptera* Verrill. Body seen from beneath, $\frac{1}{3}$ natural size; from the alcoholic specimen.

Figure 2.—The same. Part of the membrane lining the palate, enlarged 8 diameters; *a*, and *b*, from different places.

Figure 3.—The same. A single row of teeth from the odontophore, enlarged 8 diameters.

Figure 4.—The same. Teeth from the odontophore, enlarged 16 diameters; *a*, two median teeth; *b*, inner lateral teeth; *c* and *d*, teeth of the two outer lateral rows.

Figure 5.—The same. Two of the outer lateral teeth, profile-view, enlarged 16 diameters.

Figure 6.—The same. Several lateral teeth in their natural sequence, enlarged 16 diameters.

Figure 7.—The same. Two of the next to the outer lateral teeth, enlarged 16 diameters.

Figures 8 and 8^a.—The same. Twenty-second sucker from the ventral arm; front and side-views, enlarged 3 diameters.

Figure 9.—The same. One of the largest suckers from the club of the tentacular-arm; front view, enlarged 3 diameters.

Figures 8, 8^a and 9 are by J. H. Emerton; the others by the author; 2 to 7 are camera-drawings.

PLATE XXII.

Histioteuthis Collinsii Verrill. Side-view of the head and arms; from the preserved specimen, $\frac{4}{7}$ natural size. Drawn by J. H. Emerton.

PLATE XXIII.

Figure 1.—*Onychoteuthis robusta* (Dall). Side-view of one of the specimens, as found on the beach, $\frac{1}{25}$ natural size.

Figure 2.—The same. Dorsal view. The dotted lines indicate portions of the arms that had been destroyed.

Figure 3.—The same. Side-view of the head and siphon, with the anterior part of the mantle, cut open; *e*, the eye; *s*, siphon; *o*, *o'*, *o''*, the three nuchal frills; *c*, *c'*, *c''*, the smooth facets, where the mantle bears upon the neck; *c*, ventral facet of mantle; *c'*, ventral facets at base of siphon; *c''*, dorsal facet of neck; *m*, *m'*, cut edge of mantle.

Figure 4.—The same. The entire dorsal 'pen'; side-view, $\frac{1}{2}$ natural size.

Figure 5.—The same. Ventral view.

Figure 6.—The same. A portion from the middle of the 'pen,' less reduced.

All the figures were made from the fresh specimens by Mr. W. H. Dall.

Plate XXIV.

Figure 1.—*Onychoteuthis robusta* (Dall). Odontophore; side-view, enlarged $3\frac{3}{4}$ diameters.

Figure 2.—The same. Part of a row of the teeth from near the anterior bend of the odontophore, × 22 diameters; *a*, median tooth, front view; *a'*, side-view of same; *b*, first lateral; *b'*, the same, side-view; *c*, second lateral, front view; *d*, outer lateral, front view.

Figure 3.—The same. One of the inner lateral teeth, side-view, × 54 diameters.

Figure 4.—The same. Median tooth, side-view, × 54 diameters.

Figure 5.—The same. Upper mandible, natural size.

Figure 6.—The same. Lower mandible, natural size.

Figure 7.—The same. Anterior end of cone of pen, showing portion of posterior end of quill inserted into it, $\frac{1}{2}$ natural size.

Figure 8.—The same. Section of a ventral arm, close to the base, natural size; *a*, one of the suckers, side view; *b*, and *b*, marginal membranes; *c*, crest on membrane along outer angle; *e*, median vessel near inner surface.

Figures 1 to 4 are camera-drawings by the author; the rest are by J. H. Emerton.

Plate XXV.

Figure 1.—*Architeuthis Hartingii* V. Lower mandible, showing anterior portion only, natural size; 1*a*, section of a sucker of sessile arm of same; 1*b*, horny ring of same, natural size. After Harting.

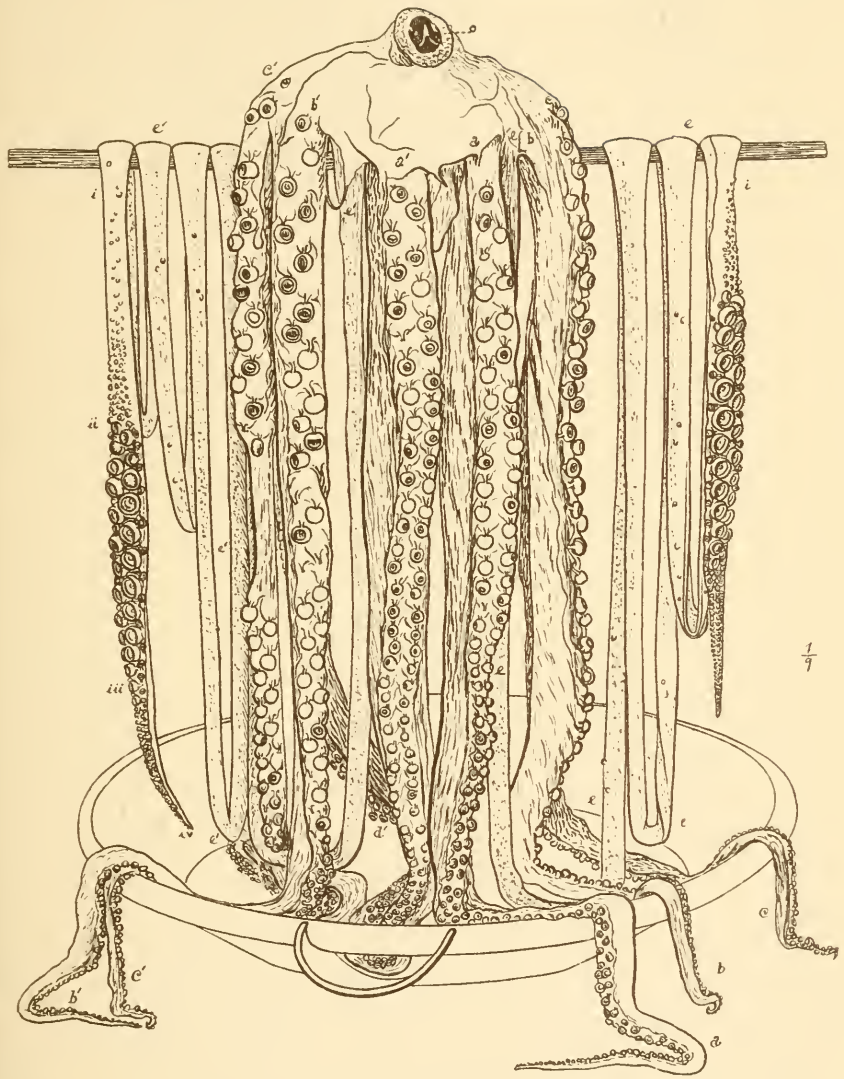
Figure 2.—*Architeuthis dux* Steenstrup. Lower mandible, natural size. Copied from Harting's figure, after Steenstrup.

Figure 3.—*Architeuthis monachus* Steenstrup (type specimen). Lower mandible, natural size. After Steenstrup.

Figure 4.—*Enoploteuthis Hartingii* Verrill. A section of one of the claw-bearing suckers, somewhat enlarged; 4*a*, the horny claw, isolated; 4*b*, median and lateral teeth of odontophore. After Harting.

Figures 5 and 5*a*.—*Architeuthis Harveyi* V. (No. 4). The two halves of the lower mandible, natural size. Camera-drawings from the specimen, by the author.

The author is greatly indebted to Professor S. F. Baird, U. S. Commissioner of Fish and Fisheries, for the use of a large number of the excellent drawings made by Mr. J. H. Emerton, of Salem, Mass., under the direction of the author, for the Fish Commission, many of which are included in these plates.



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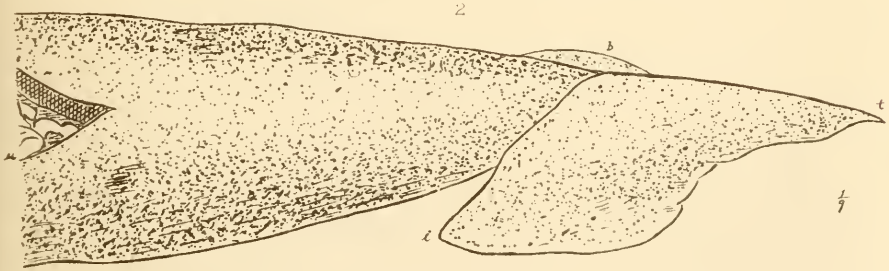

A.E. Verrill & J.H. Emerton

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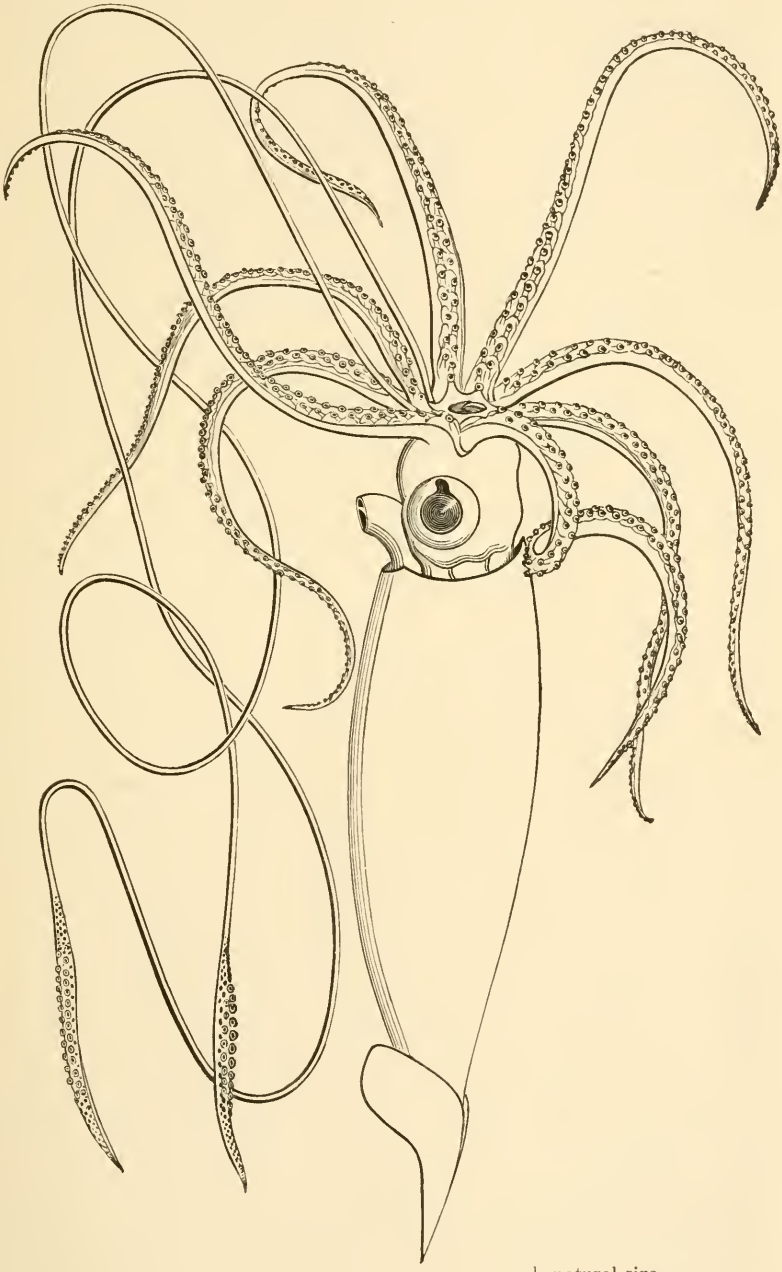
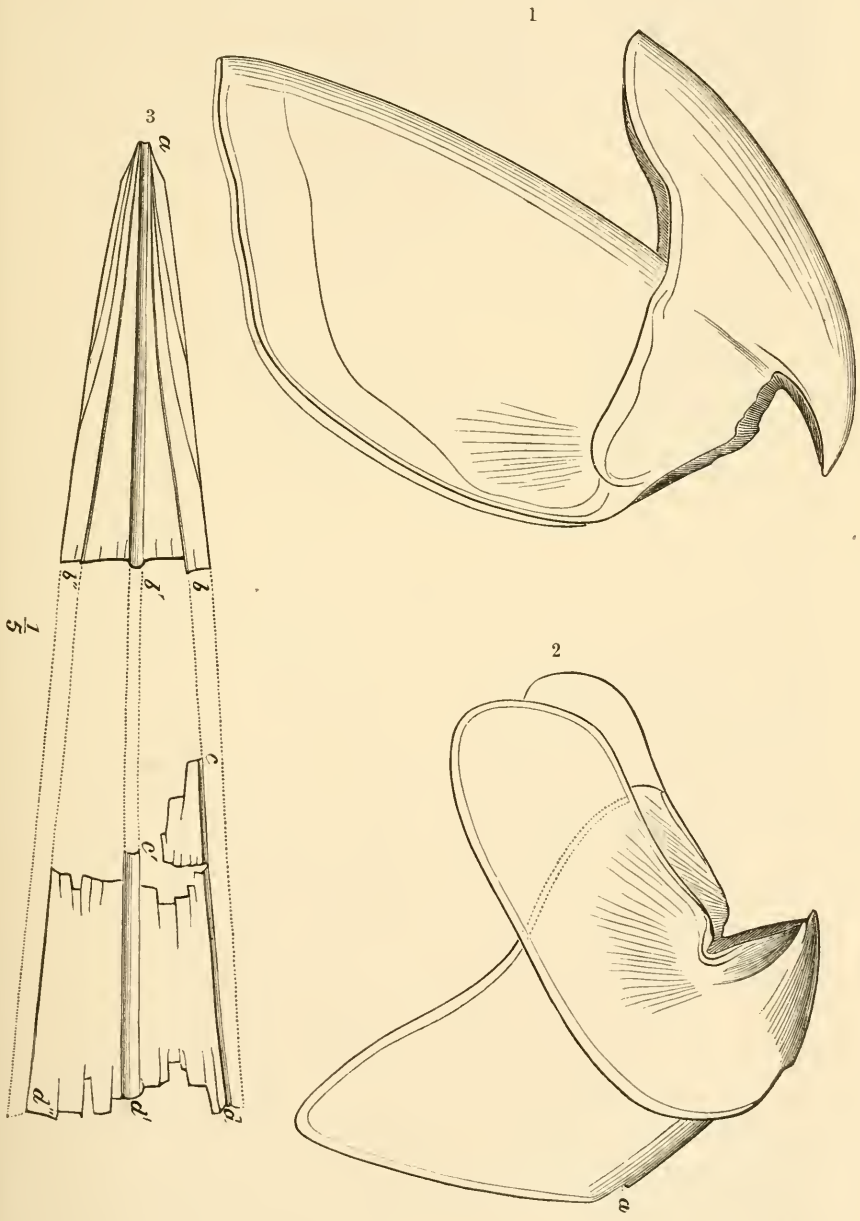


$\frac{1}{2}\frac{1}{7}$ natural size.

Architeuthis Harveyi.



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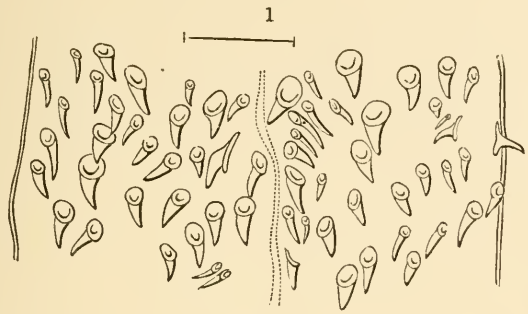
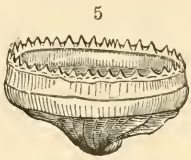
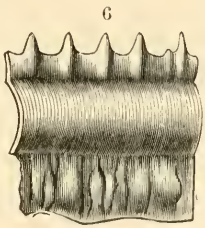
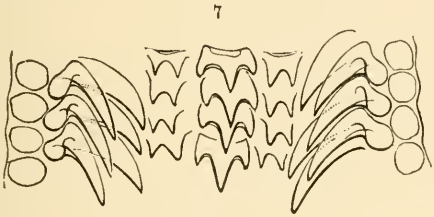
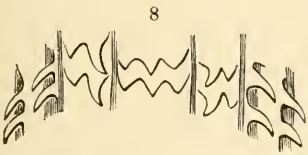
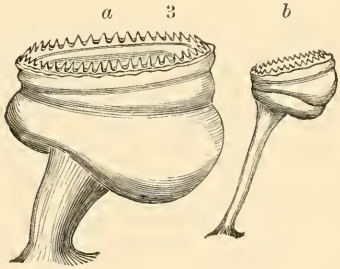


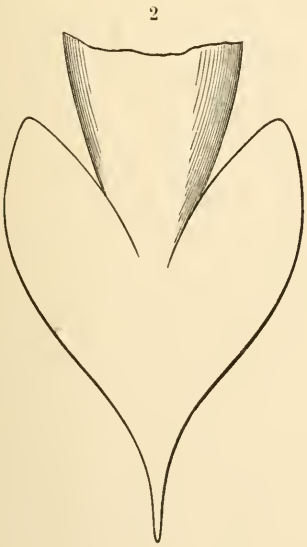


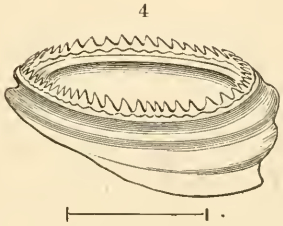




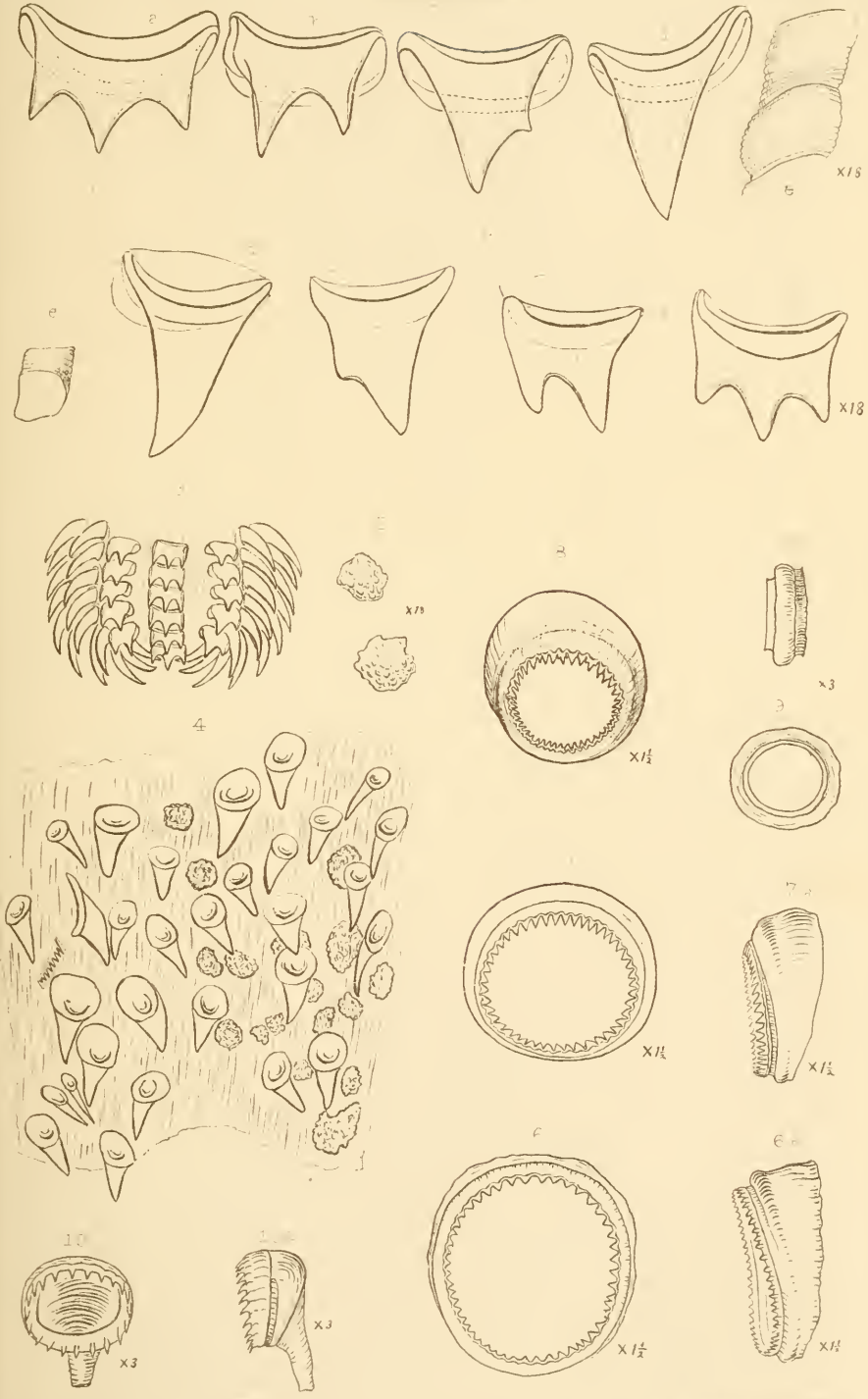








Architeuthis Harveyi, etc.



A. E. Verrill & J. H. Emerton from nature

Phot. Lith. Funder[illegible]

ARCHITEUTHIS HARVEYI VERRILL

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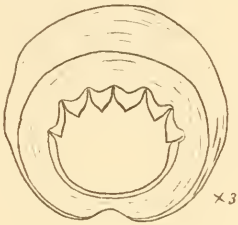
×1½

2a
×1½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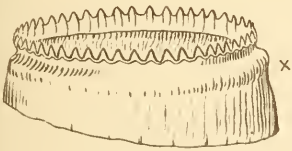
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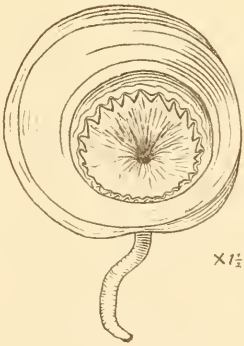
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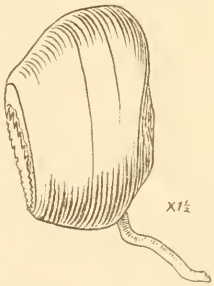
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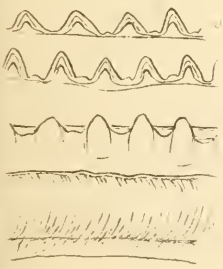
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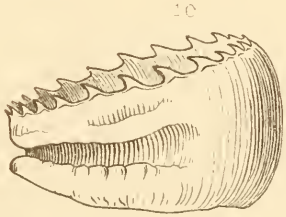
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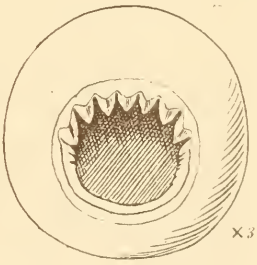
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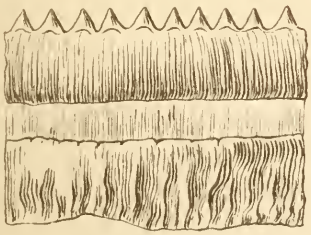
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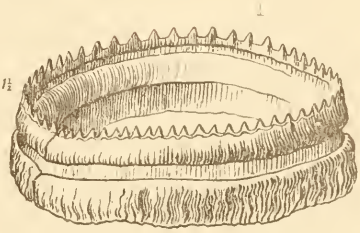
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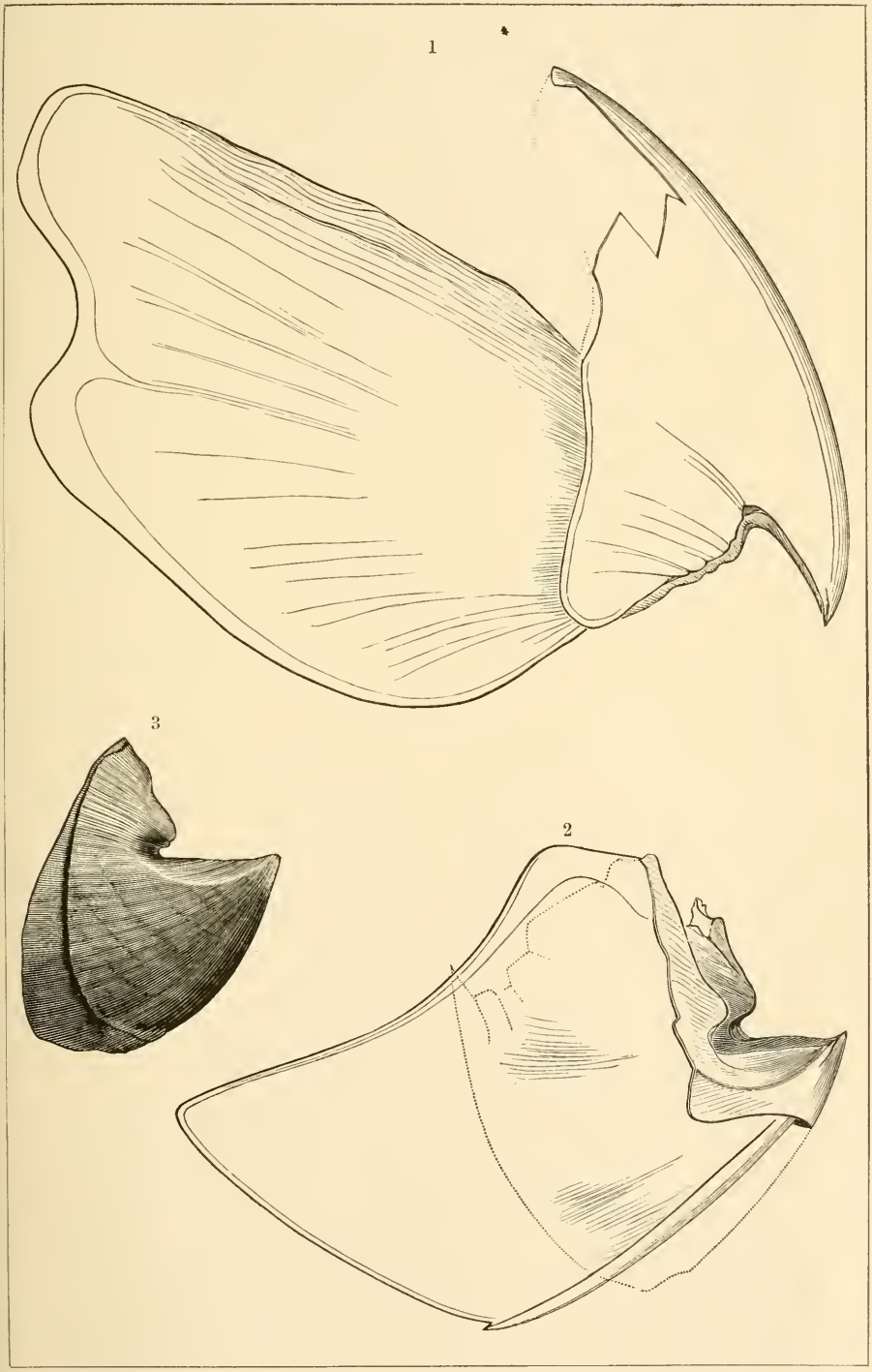
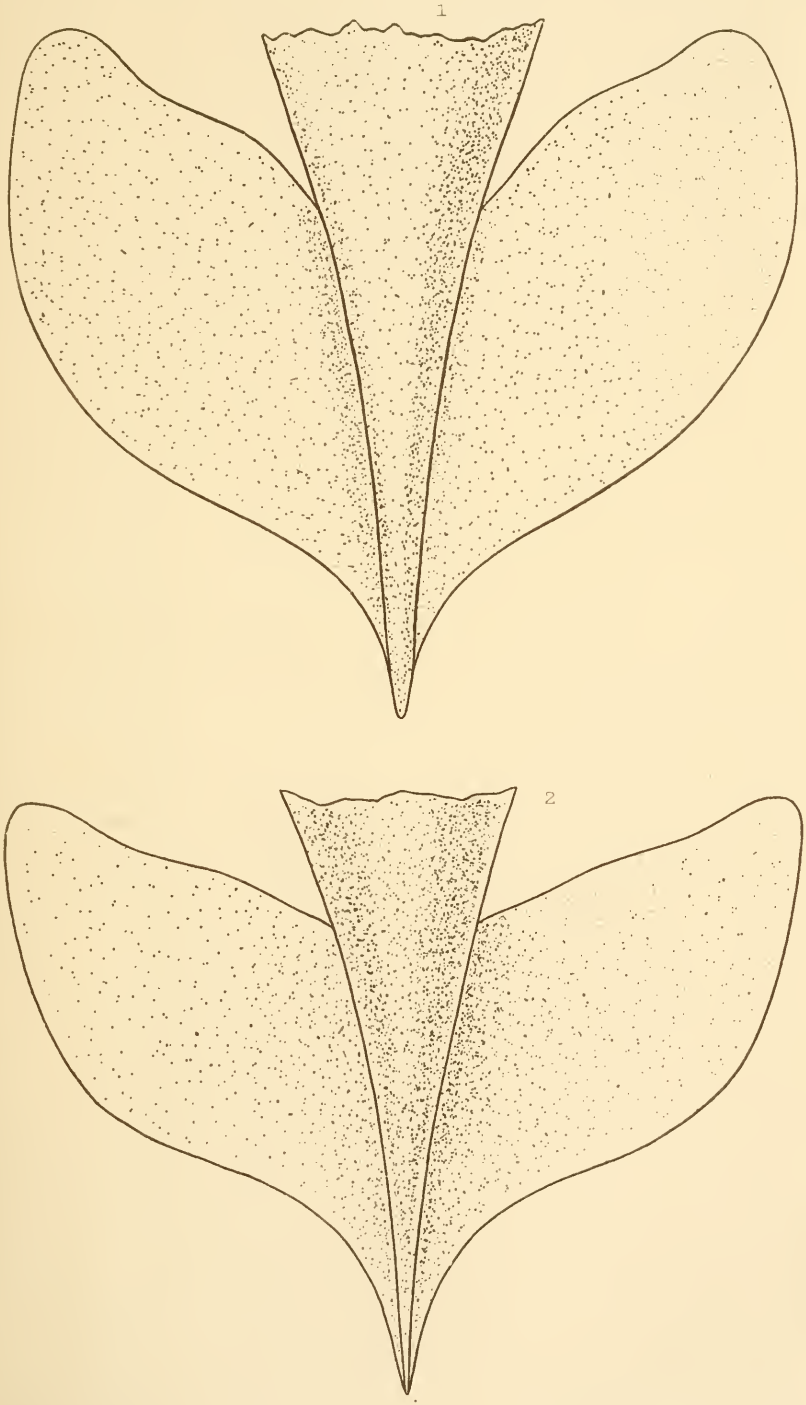


Architeuthis princeps.



A. E. Verrill & J. B. Holder from nature

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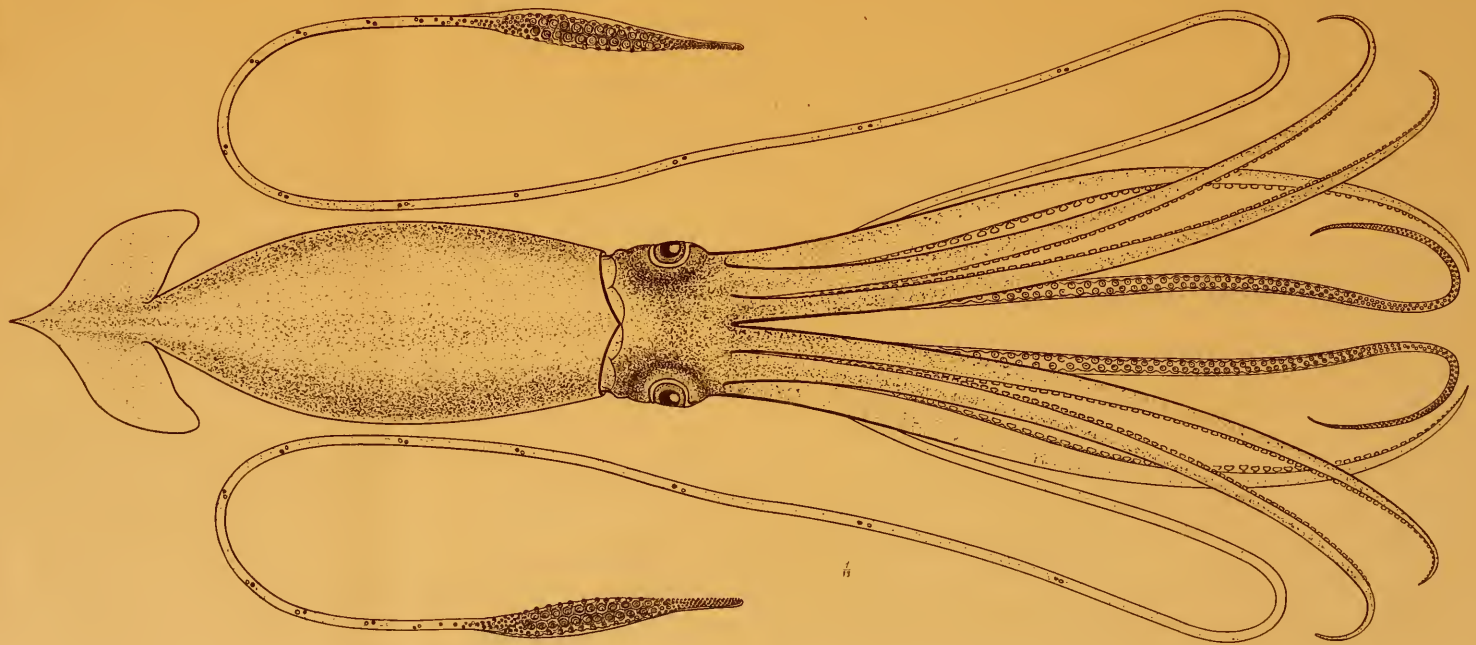
ARCHITEUTHIS PRINCEPS VERRILL



ARCHITEUTHIS PRINCEPS VERRILL

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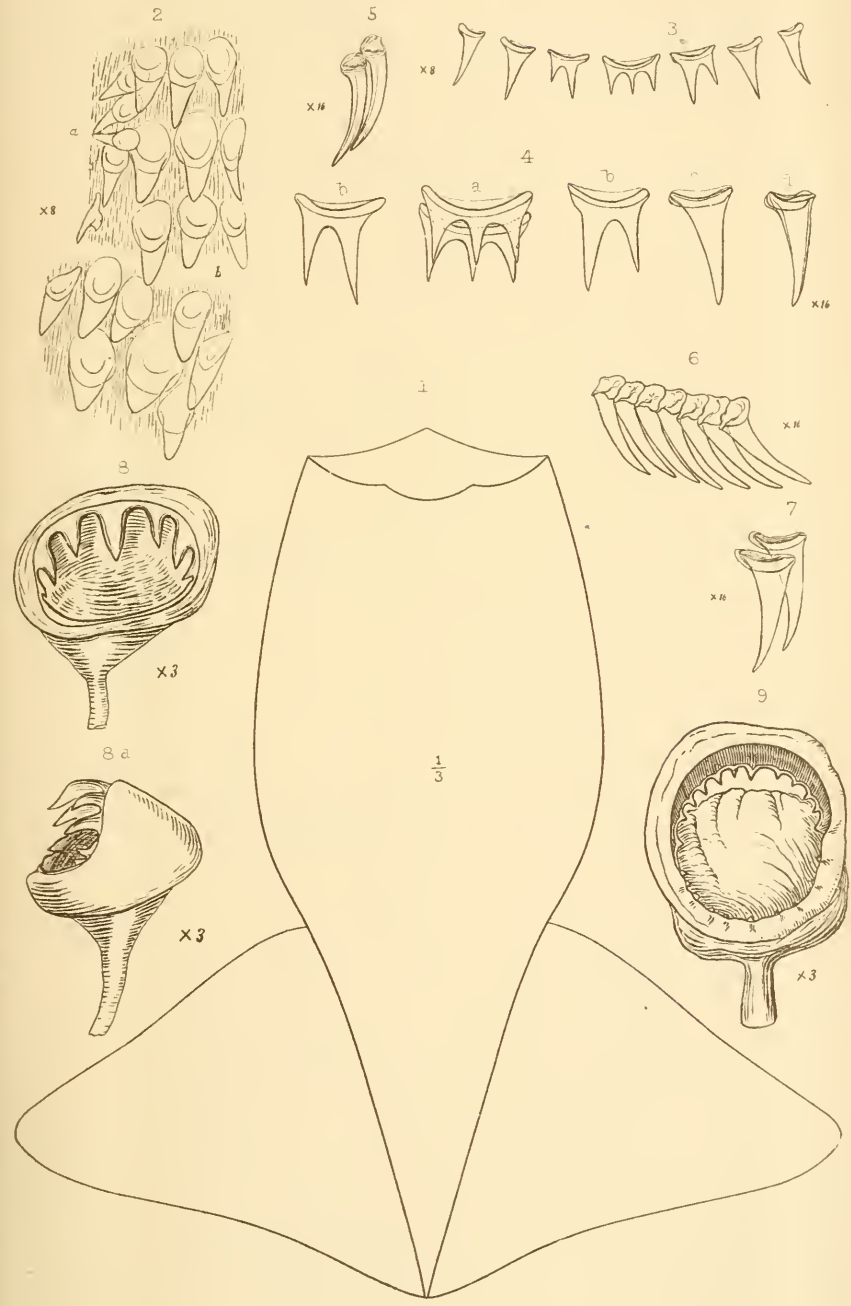

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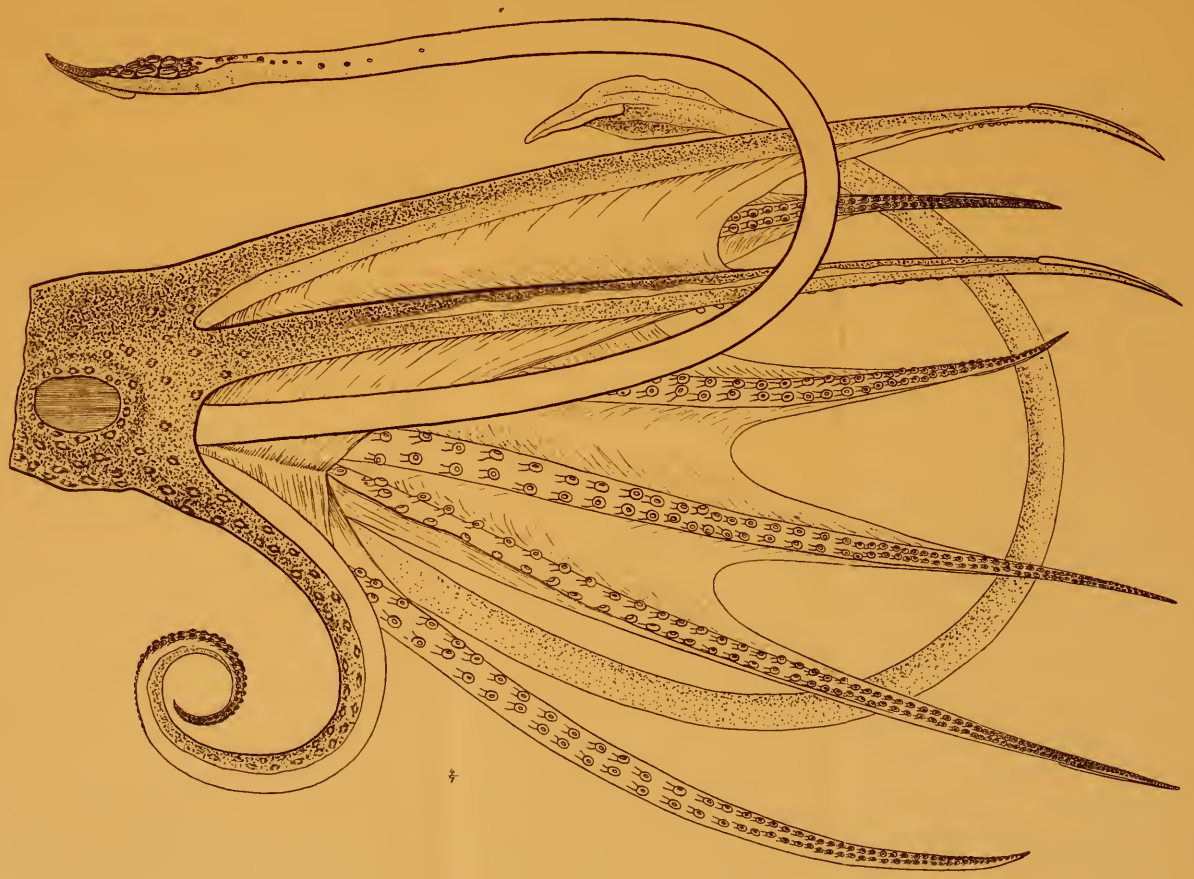
ARCHITEUTHIS MEGAPTERA VERRILL



HISTIOTEUTHIS COLLINSII VERRILL

J. H. Emerton from nature.

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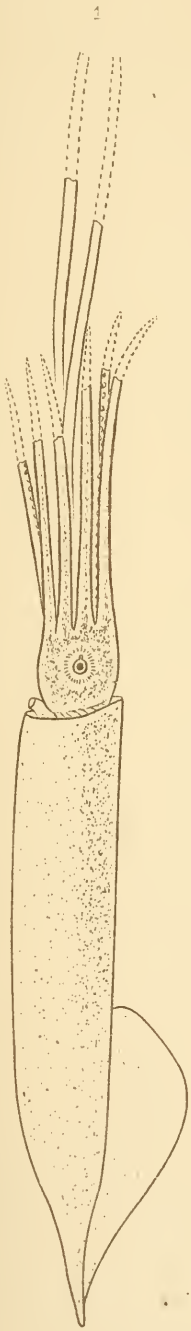
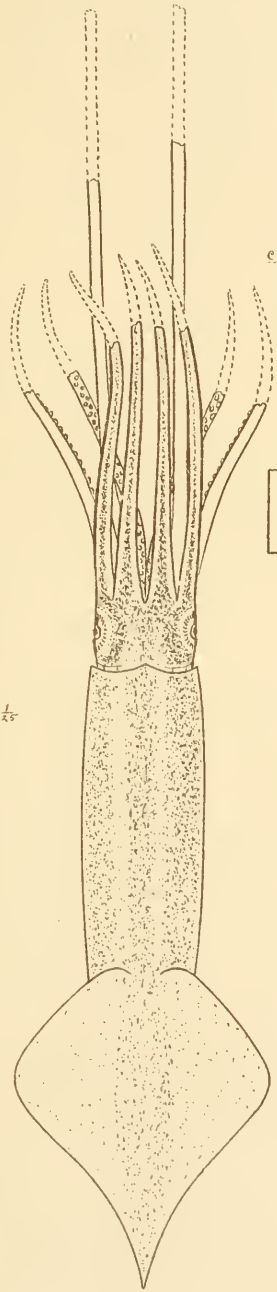
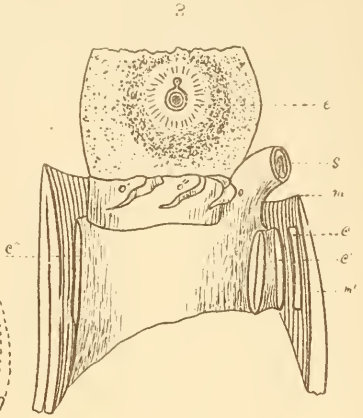
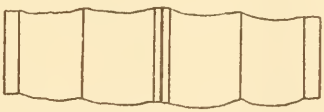




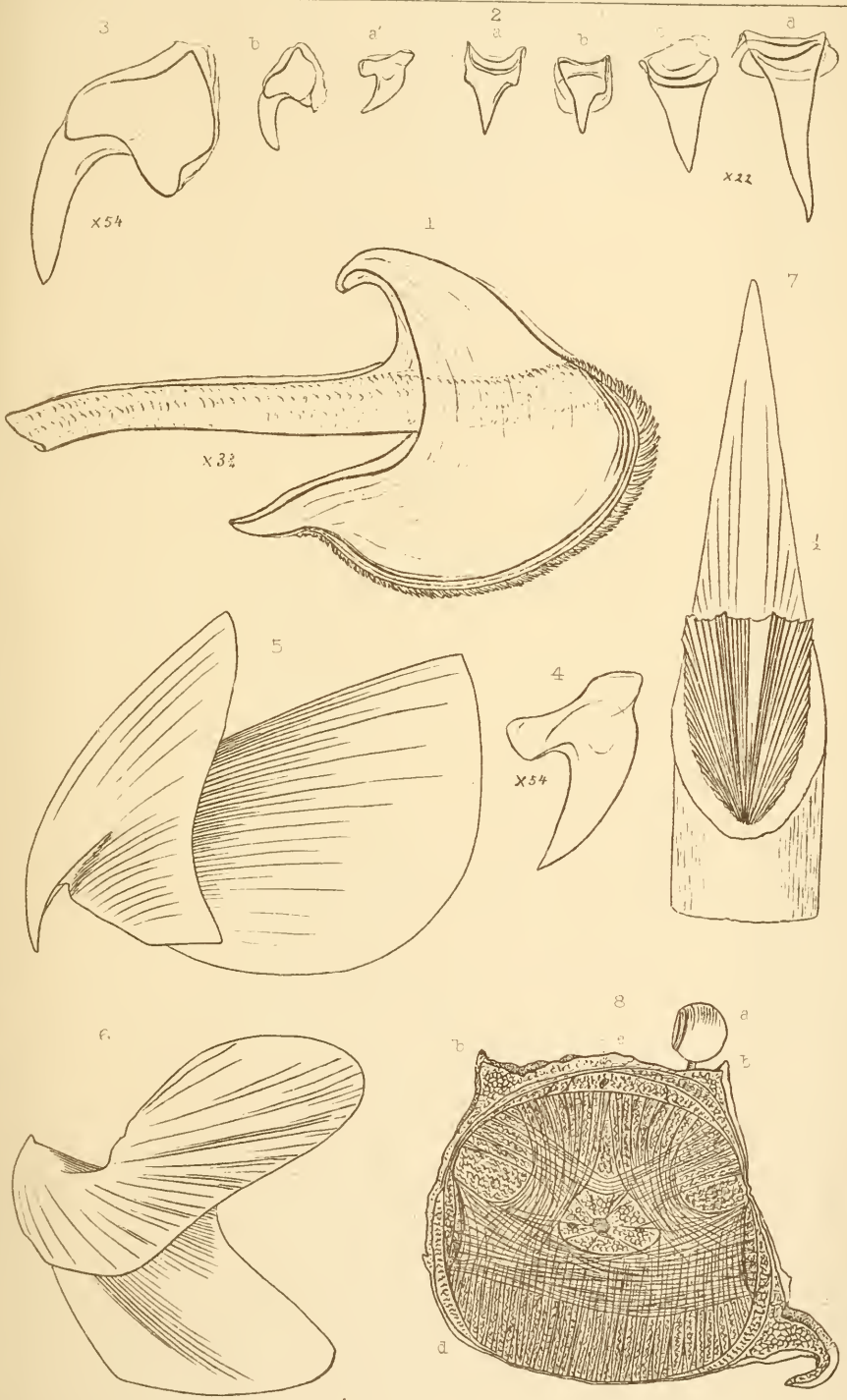




W. H. Dall from nature

Photo Lith. Fundergon & Cristadoro, New Haven Ct.

ONYCHOTEUTHIS ROBUSTA (Dall)



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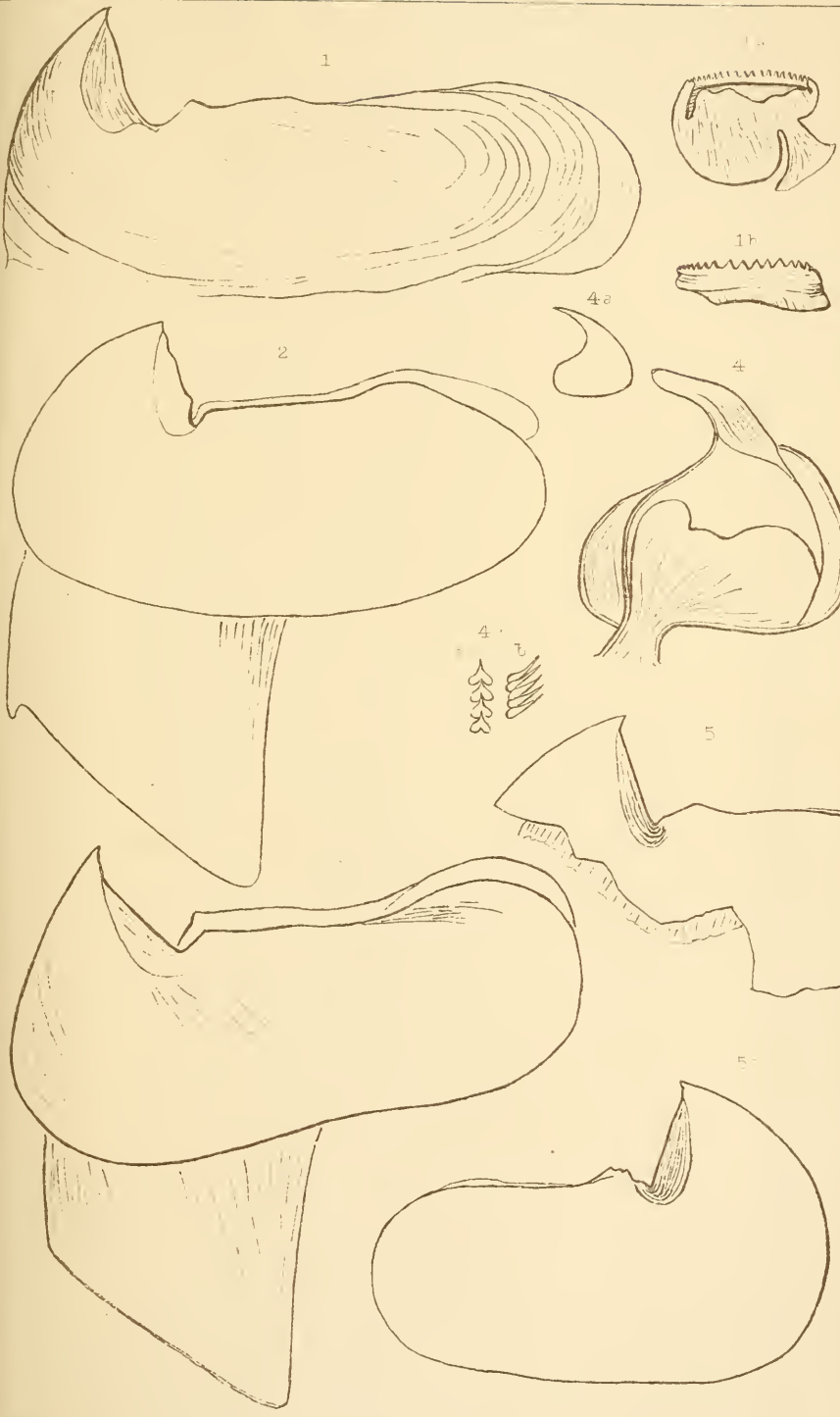


A. E. Verrill, del. Photo Lith. Punderson & Crisand, New Haven, Ct.

THE CEPHALOPODS OF THE NORTH-EASTERN COAST OF AMERICA.

PART II.

The smaller Cephalopods, including the Squids and the Octopi, with other Allied Forms.

By A. E. VERRILL.

[From the Transactions of the Connecticut Academy of Sciences, Vol. V.]

New Haven, Conn., June, 1880–December, 1881.

The Cephalopods of the Northeastern Coast of America.

By A. E. Verrill.

Part II. the smaller cephalopods, including the "squids" and the octopi, with other allied forms.

Before proceeding with the special subjects of this Part it seems desirable to describe in detail an important, though young and small, example of one of the gigantic species of *Architeuthis*, as a supplement to the first part of this article.

Description of a young example of Architeuthis Harveyi.

Plates XXVI and XXXVIII.

This specimen, which I have designated as No. 24, was received subsequent to the publication of the previous part of this article. It was found, dead and mutilated, floating at the surface, at the Grand Bank of Newfoundland, April, 1880, by Capt. O. A. Whitten and crew of the schooner "Wm. H. Oakes," and by them it was well preserved and presented to the U. S. Commission of Fish and Fisheries. It is of great interest because it furnishes the means of completing the description of parts that were lacking or badly preserved in the larger specimens, especially the sessile arms and the buccal membranes.

The specimen consists of a part of the head with all the arms attached, and with the suckers in a good state of preservation on all the arms, though the tips of all the short arms, except one, are destroyed, and all of the arms are more or less injured on their outer surfaces. The jaws and buccal membranes are intact, with the odontophore and œsophagus. Parts of the cartilaginous skull, with some of the ganglia and the collapsed eyes are present, but the external surface of the head is gone and the eyelids are badly mutilated. No part of the body was preserved. The tentacular-arms are in good preservation, with all the suckers present. Unfortunately the distal portions of both the ventral arms had been destroyed, so that the sex cannot be determined. The color of the head, so far as preserved, and of the external surfaces of the sessile arms is much like that of the common squids,—a rather dark purplish brown, due to minute crowded specks of that color, thickly distributed, with a pink-

ish white ground-color between them. The outer buccal membrane is darker; the inner surfaces of the arms are whitish; the peduncular portions of the tentacular arms have fewer color-specks, and are paler than the other arms.

Reproduction of lost parts.

This creature had been badly mutilated long before its death, as its healed wounds show, and to this fact many of the imperfections of the specimen are due. At the time of its death, or subsequently, the extremities of the ventral arms and of the third right arm appear to have been destroyed, besides other injuries. But both the dorsal arms and both the lateral arms of the left side had previously been truncated at 12 to 13 inches from their bases. The ends had not only healed up entirely, but each one had apparently commenced to reproduce the lost portion. The reproduced part consists, in each case, of an elongated, acute, soft papilla, arising from the otherwise obtuse end of the arm. At its base one or two small suckers have already been reproduced, and minute rudiments of others can be detected on some of them. Whether these arms would have been perfectly restored in course of time is, perhaps, doubtful,* but there can be no doubt that a partial restoration would, at least, have been effected. On the basal half of several of the arms some of the suckers had also been previously lost, and these were all in the process of restoration. The restored suckers were mostly less than one half the diameter of those adjacent, and in some cases less than one-third. Among the restored suckers were some malformations. One has a double aperture, with a double horny rim. In one case two small suckers, with pedicels in close contact, occupy the place of a single sucker. In another instance a small pedicelled sucker arises from the pedicel of a larger one, near its base.

The arms and suckers.

With the exception of the left arm of the second pair, none of the sessile arms have their tips perfect. Therefore it is not possible to give their relative lengths. The dorsal arms are the smallest at base and the third pair largest. They are all provided with a rather narrow marginal membrane along each border of the front side. These membranes are scarcely wide enough to reach to the level of the rims of the suckers, though they may have done so in life. The front margin, bearing the suckers is narrow on all the arms, but relatively

* That mutilations of the arms in species of *Octopus* are regularly restored is well-known, but it has been doubted whether this occurs in the ten-armed forms.

wider on the ventrals than on any of the others. Each sucker-pedicel arises from a muscular cushion, that is slightly raised and rounded on the inner side; these, alternating on the two sides, leave a zigzag depression along the middle of the arm; from each of these cushions two thickened muscular ridges run outward to the edge of the lateral membranes, one on each side of the pedicels of the suckers. These transverse muscular ridges give a scolloped outline to the margin of the membranes. These marginal membranes are narrowest and the suckers are smallest on the ventral arms. The dorsal and lateral arms are strongly compressed laterally, but slightly swollen or convex in the middle, and narrowed externally to a carina, which is most prominent along the middle of the arms, and most conspicuous on the third pair of arms. The dorsal arms are rather more slender than the second pair, and were probably somewhat shorter.

The left arm of the second pair has the tip preserved, with all its suckers present. On this arm there are 330 suckers, in all. The total length of the arm is 26·25 inches. The first 50 suckers extend to 12·25 inches from the base; the next 50 occupy 4·5 inches; the next 50 cover 3·5; the next 100 occupy 4·25 inches; the last 80 occupy 1·75 inches. This arm is ·80 of an inch in transverse diameter, near the base; 1·20 inches from front to back; breadth of its front or sucker-bearing surface (without the lateral membranes), is, where widest, near the base of the arm, ·50 of an inch; the width gradually decreases, to ·18 of an inch at 20 inches from the base; beyond this the arm tapers to a very slender tip, with numerous small crowded suckers in two regular rows. At the base (Plate XXVI, fig. 4) there is first one very small sucker; this is succeeded by two or three much larger ones, increasing a little in size; beyond these are the largest suckers, extending to about the 25th, beyond which they gradually change their form and regularly diminish in size to the tips. The larger proximal suckers, up to the 25th to 30th, are relatively broader than those beyond, and have a wider and more open aperture, and a more even and less oblique horny ring, which is sharply denticulate around the entire circumference, with the denticles rather smaller on the inner than on the outer margin, but similar in form. These are about ·31 of an inch in external diameter. They show a gradual transition to those with more oblique rims and smaller apertures. Beyond the 30th, the horny rims become decidedly more oblique and one-sided, with the denticles nearly or quite abortive on the inner side, and larger and more incurved on the outer margin, while the aperture becomes more contracted and oblique.

At first there are 8 to 10 denticles on the outer margin, but these diminish in number as the suckers diminish in size, till at about 6 inches from the tip there are mostly but two or three, and the aperture is very contracted. Still nearer the tip there are but two, blunt ones; then these become reduced to a single bilobed one; and finally only one, which is squarish, appears in the minute suckers of the last two inches of the tip. The first two or three suckers at the base of the arm are more feebly denticulated than those beyond, with smaller apertures.

On many of the suckers (Plate XXXVIII, fig. 3) there are still remaining, in more or less complete preservation, a circle of minute horny plates arranged radially, or transversely, on the edge of the membrane around the aperture, similar in arrangement to those already described in the former part of this article (p. 230) on the suckers of *Sthenoteuthis pteropus* (Plate XXXVI, fig. 9). They are less developed, however, than in that species, being thinner and more delicate, nor do their ends appear to turn up in the form of hooks. They seem to be generally very thin, oblong, scale-like structures, with rounded or blunt ends and slightly thickened margins. These structures will probably be found to vary with age, and perhaps with the season. They appear to be easily desiduous, and are often absent in preserved specimens.

On the dorsal and third pairs of arms the suckers have essentially the same arrangement, form and structure, and on these three pairs of arms the larger suckers differ but slightly in size. The character and arrangement of the suckers on the distal portion of these arms is well shown on Plate XXVI, figs. 3, 3*a*, which represent a portion of one of the third pair of arms, commencing at the 67th sucker.

The ventral arms are trapezoidal in section, at base, and rather stout. Breadth of front surface, near the base, exclusive of membranes, ·55; transverse diameter, ·95; front to back, 1·25 inches. The sucker-bearing surface is, therefore, broader than in the other arms. The suckers are, however, distinctly smaller and the proximal ones are different in form from the corresponding ones on the other arms. They are narrower and deeper, with more oblique and more contracted apertures, more oblique horny rims, which are denticulated on the outer margins only. On the larger ones there are 12 to 15 sharp incurved denticles. In fact, the proximal suckers on the ventral arms agree better with the middle suckers, beyond the 30th, on the other arms, for there are none having wide open apertures, surrounded by nearly even horny rims, denticulated all around. The

Young Architeuthis Harveyi. · *Measurements of arms* (in inches).

		Near base.	At 5 in.	At 10 in.	At 15 in.	At 20 in.
Dorsal pair.						
Breadth of front, exeluding membranes,	--	·35	·50	·30	--	--
Breadth of lateral membranes,	--	·20	·30	·20	--	--
Diameter, transversely,	--	·75	·60	·40	--	--
Diameter from front to back,	--	1·05	·90	·70	--	--
Second pair.						
Total length,	26·25	--	--	--	--	--
Breadth of front,	--	·40	·50	·35	·22	·18
Breadth or membranes,	--	·25	·30	·15	--	--
Diameter, transversely,	--	·80	·65	·35	·30	·16
Diameter, front to back,	--	1·20	1·20	·85	·60	·40
Third pair.						
Breadth of front,	--	·50	·50	·40	--	--
Breadth of membranes,	--	·20	·25	·15	--	--
Diameter, transversely,	--	1·10	·70	·40	--	--
Diameter, front to back,	--	1·08	1·60	1·20	--	--
Fourth pair.						
Breadth of front,	--	·40	·55	·30	--	--
Breadth of membranes,	--	·20	·25	·10	--	--
Diameter, transversely,	--	·98	·90	--	--	--
Diameter, front to back,	--	1·40	1·12	--	--	--
Tentacular-arms.						
Total length,	67·	--	--	--	--	--
Base to expansion of club,	58·75	--	--	--	--	--
Diameter of slender portion,	·4–·6	--	--	--	--	--
Length of club,	8·25	--	--	--	--	--
Length of part occupied by 24 largest suckers,	4·25	--	--	--	--	--
Length of part occupied by small distal suckers,	2 60	--	--	--	--	--
Greatest breadth of club,	·70	--	--	--	--	--
Diameter, front to back,	·60	--	--	--	--	--

Sessile arms, from base to particular suckers.

	To 25th.	To 50th.	To 100th.	To 150th.	To 200th.	To 250th.	To 300th.	To tip.
Dorsal pair, base to suckers,	7·5	12·25	--	--	--	--	--	--
Second pair, base to suckers,	7·75	12·25	16·75	20·25	22·90	24·50	25·75	26·25
Third pair, base to suckers,	7·25	12·25	--	--	--	--	--	--
Fourth pair, base to suckers,	6·25	10·	16·50	20·75	--	--	--	--

Measurments of suckers of sessile arms (in inches).

	15th.	30th.	50th.	100th.
On 1st pair of arms, external diameter,	·31	·24	·16	--
On 1st pair of arms, aperture diameter,	·25	·15	·10	--
On 2d pair of arms, external diameter,	·31	·27	·20	·15
On 2d pair of arms, aperture diameter,	·25	·18	·11	·08
On 3d pair of arms, external diameter,	·31	·28	·22	--
On 3d pair of arms, aperture diameter,	·22	·18	·12	--
On 4th pair of arms, external diameter,	·25	·21	·16	·14
On 4th pair of arms, aperture diameter,	·15	·11	·10	·07

suckers diminish regularly in size, and in the number of denticles, till at the 200th (where the arms are broken off) there are but three denticles.

Tentacular-arms.

Plate XXVI, fig. 2.

The tentacular-arms are both entire, with all the suckers well preserved. The total length is 65 and 67 inches respectively; length of the expanded portion or club, 8·25 inches; diameter of the peduncular portion varies from ·40 to ·70 of an inch; at the base, ·90; breadth of the proximal part of the club, where it is broadest, ·70; diameter from front to back, ·60; external diameter of the largest suckers, ·35 of an inch; height of their cups, ·28; of lateral suckers, ·18; of the largest marginal suckers on the distal portion, ·14.

The peduncular portion is somewhat thickened and rounded at the base, but through most of its length it is slender, varying in size, and nearly triangular in section, with the corners rounded, each side measuring, where largest, ·60 of an inch in breadth. At about a foot from the base the small smooth-rimmed suckers and their opposing tubercles begin to appear on the inner surface. At first these are placed singly and at considerable intervals (2·5 to 3·5 inches), each sucker alternating with a tubercle on each arm; further out they are nearer together, and towards the club they alternate, two by two, on each arm; near the commencement of the club they become more numerous and are arranged somewhat in two rows; just at the commencement of the club they become more crowded, forming three and then four oblique transverse rows of suckers, with the same number of tubercles alongside of them; on the basal expansion of the club, which is its thickest portion, these suckers and tubercles become very numerous, covering nearly the whole inner surface, forming rather crowded and irregular oblique rows of six or more. These smooth-rimmed suckers are followed by an irregular group of about twenty, somewhat larger, denticulated suckers, occupying the entire breadth for a very short distance. Then follow the two median rows of large suckers, alternating with a row of marginal ones, of about half their size, on each side. The first three or four large suckers of each row gradually increase in size; then follow six to eight nearly equal ones of the largest size; these are followed by two to four distal ones, decreasing in size. In one of the rows there are fourteen that distinctly belong to the large series; in the other row there are twelve. The distal section of the club is occupied by

four regular rows of small denticulated suckers, more strongly toothed on the outer margins, and similar in form to the marginal suckers of the middle region. Of these the two rows next the upper (?) margin are decidedly larger than those of the two lower (?) rows. Close to the tip there is a group of about a dozen minute suckers, with smooth even rims. The middle portion of the club is bordered on each side by a rather broad, thin scalloped membrane. The distal section has a broad keel on the outer margin.

Suckers of tentacular-arms.

Diameter of largest,	·35
Height of largest,	·28
Diameter of lateral,	·18
Height of lateral,	·09
Diameter of smooth-rimmed ones,	·10
Diameter of tubercles,	·08
Of largest lateral ones of distal section,	·14
Of median lateral ones of distal section,	·11

Buccal membranes and jaws.

Plate XXVI, fig. 7.

This specimen fortunately had the buccal membranes and other parts about the mouth perfectly preserved, which has not been the case in the large specimens. The outer buccal membrane is broad and thin, rather deeply colored externally. Its margin extends into seven acute angles—one of which is opposite each of the lateral and ventral arms, but on the dorsal side there is only one, which corresponds to the interval between the two dorsal arms. From each of these angles a membrane runs to, and for a short distance along the side of the opposite arm, except from the dorsal one, which sends off a membrane which divides, one part going to the inner lateral surface of each dorsal arm. The membranes from the upper lateral and ventral angles join the upper lateral sides of their corresponding arms; those from the lower lateral angles go to the lower lateral sides of the third pair of arms. The inner surface of the buccal membrane is whitish and deeply and irregularly reticulated by conspicuous, soft, wrinkles and furrows, which become somewhat concentric toward the margin. Beneath this membrane are openings to the aquiferous cavities. The inner buccal membrane, immediately surrounding the beak, is whitish, thickened at the margin, and strongly irregularly wrinkled and puckered.

The jaws have sharp, dark brown tips, changing to clear brown backward, with the laminæ very thin, transparent, and whitish. The

upper mandible has the rostrum regularly curved, with a distinct ridge, in continuation with its inner edges, extending down the sides, and only a slight notch at its base.

The lower mandible has a notch close to the tip, with the rest of the inner edge nearly straight; at the base is a rather large and wide V-shaped notch; the tooth beyond it being broad-triangular and rather large; beyond the tooth the alæ are white, soft and cartilaginous.

Measurements of jaws (in inches).

Transverse diameter of buccal mass,	1·50
Vertical diameter of buccal mass,	1·70
Upper Mandible:	
Tip to end of frontal lamina,	1·25
Tip to notch,	·37
Tip to lateral border of lamina,	·77
Lower Mandible:	
Tip to border of mentum,	·45
Tip to lateral border of alæ,	·70
Tip to inner end of alæ,	1·02
Tip to bottom of notch,	·32
Height of tooth,	·06
Notch to inner end of alæ,	·80
Mentum to inner end of alæ,	1·20

The portion of the œsophagus preserved is 14·75 inches long and about ·15 of an inch broad, in its flattened condition.

The odontophore (Plate XXXVIII, figs. 1, 2) is amber-color, ·18 of an inch broad. The tridentate median teeth have moderately long but not very acute points, of which the middle one is a little the longest. The inner lateral teeth are bidentate and somewhat broader and longer than the median ones; their outer denticle is well-developed, but considerably shorter than the inner one. The next to the outer lateral teeth are larger at base and much longer, simple, broad, tapering, flattened, slightly curved, acute at tip. They appear not to have the small lateral denticle observed on the corresponding teeth of the adult *Architeuthis* (see Plate XVI*a*, figs. 1, 2). The outer lateral teeth are similar to the preceding, but rather larger and not quite so broad at base. The marginal plates are well-developed, thin, somewhat rhomboidal.

The internal cavity of the ears is somewhat irregularly three-lobed, with several rounded papillæ projecting inward from its sides, very much as in those of *Ommastrephes*. Each ear contained two irregular-shaped otoliths, one of which (Plate XXXVIII, fig. 4) was much larger than the other, in each ear.

The eyes were both burst, and most of their internal structure was destroyed. So far as preserved they closely agree with those of

Ommastrephes. The eye-balls were large and somewhat oblong in form, and appear to have been nearly two inches broad and three long. The eye-lids are badly mutilated, but the anterior sinus can be imperfectly made out. It seems to have been broad and rounded. The aquiferous cavities appear to have been like those of *Ommastrephes.* The form and structure of the cartilaginous 'brain-box' also appear to be essentially the same as in the genus last named.

Ommastrephes.

Ommastrephes (pars) D'Orbigny, Voy. Am. Merid., 1835; Cephal. Acétabulifers, p. 341.

Body elongated, pointed posteriorly. Caudal fin broad, transversely rhomboidal. Pen narrowed behind the middle, with a strong median rib and large marginal ribs on each side; near the posterior end thin and concave, expanded into a lanceolate form, with the tip infolded and slightly hooded. Head large. Eyes with lids, having a distinct sinus in front.

Arms stout, the third pair stoutest, with a dorsal keel; all the arms have marginal membranes exterior to the suckers. Suckers of the arms deep and oblique, with horny rims which are strongly denticulate on the outer margin, the median tooth usually largest. Tentacular-arms rather long and contractile, stout, with a moderately wide terminal club, which has along its middle region two rows of large central suckers, and a row of smaller marginal ones alternating with them, on each side; proximal part of club with small denticulate suckers only; distal part of club with four to eight rows of small denticulate suckers.

Siphon-tube placed in a depression of the under side of the head, and attached to the head by a lateral bridle on each side, behind the eyes, and by a pair of bridles on its dorsal surface, at the bottom of the depression in which it is lodged. Terminal orifice transversely elliptical, furnished with an internal valve.

Mantle-fastenings ('apparatus of resistance'), situated on the basal extension of the siphon, consist, on the ventral side, of two large triangular bosses, with an elongated and somewhat ear-shaped longitudinal fosse, and a shallower transverse one; and on each side of the inner surface of the mantle, of a corresponding short, raised, longitudinal ridge, swollen posteriorly, and a lower transverse ridge, which fit closely into the fosses. The dorsal side of the head has a median, longitudinal facet, that fits upon its counterpart on the mantle, over the anterior part of the pen, which gives it support.

The nuchal lamellæ are formed by a transverse tegumentary fold behind the eyes, from which run backward, on each side, three longitudinal lamellæ, which are delicate, and have a sensory (perhaps olfactory) function.

Buccal membrane seven-angled, thin, corrugated on the inner surface, destitute of suckers.

Branchial auricles, and gills large. Liver and stomach voluminous.

The male has one of the ventral arms (which may be either right or left in our species) hectocotylized near the tip, by enlargement and flattening of the bases of the sucker-stalks, while their cups become small or abortive.

The female has oviducts developed on both sides, but they are small, and simple, opening far back. Two pairs of nidamental glands, which are small and simple.

Ommastrephes illecebrosa Verrill. (Short-finned squid.)

Loligo illecebrosa Lesueur, Journ. Phil. Acad. Nat. Sci., ii, p. 95, Plate 10, figs. 18–21, 1821 (figures incorrect).

Blainville, Dict. des Sci. nat., vol. xxvii, p. 142, 1823.

Gould, Invert. Mass., ed. I, p. 318, 1841 (habits).

Loligo piscatorum La Pylaie, Ann. des Sci. nat., iv, p. 319, 1825, Pl. 16 (habits as observed at Saint Pierre).

Ommastrephes sagittatus (*pars*) D'Orbig., Cephal. Acétab., p. 345, Plate 7, figs. 1–3 (after Lesueur).

Gray (*pars*), Catalogue Moll. of British Mus., Part I, Cephal. Antep., p. 58, 1849.

Binney, in Gould's Invert. Mass., ed. II, p. 510, 1870 (excl. syn.), Pl. 26, figs. 341–4 [341 is imperfect],* *not* Plate 25, fig. 339.

Tryon (*pars*), Man. Couch., I, p. 177, Pl. 78, fig. 342 (very poor, after Lesueur), Pl. 79, fig. 343, 1879 (*not* Plate 78, figs. 341, 345).

Ommastrephes illecebrosa Verrill, Amer. Jour. Sci., vol. iii, p. 281, 1872 (synonymy); Report on Invert. Viney. Sd., etc., 1873, pp. 441 (habits), 634 (descr.); Amer. Jour. Science, vol. xix, p. 289, April, 1880.

Plates XXVIII; XXIX, figs. 5, 5*a*; XXXVII, fig. 8; XXXIX.

Body, in the younger specimens, long and slender; in the adults, especially when the stomach is distended with food, and in the breeding season, rather stout; most so in the gravid female; in preserved specimens the apparent stoutness of the body depends very much upon whether the mantle was in a contracted or expanded

* This species is not well figured in the last edition of Gould's Invertebrates. Plate 25, fig. 339, which Mr. Binney refers to it, really represents a *Loligo*. Plate 26, figs. 341–344 (erroneously referred to *Loligopsis pavo*), was doubtless made from a specimen of this species, but if so, the long arms were incorrectly drawn, and confused with the short arms.

state when the animal died. Caudal fin transversely rhomboidal, or broad spear-shape, about one-third wider than long; its breadth usually less than half the length of the mantle; the posterior borders are nearly straight and form nearly a right angle at the posterior end; the anterior margins are somewhat convexly rounded, and the front margin extends, at the sides of the body, considerably forward beyond the insertion of the fin. Ratio of fin-length to mantle-length 1 : 2·48 to 1 : 3·00 (the latter in the young ones). Average proportions in eight adult specimens: of fin-length (from insertion) to length of dorsal side of mantle, about 1 : 2·55; breadth of fin to length of mantle, average, 1 : 1·90; length of head (dorsal edge of mantle to base of arms) to mantle-length, average, 1 : 7·15.

The head is large, well-rounded; the exposed portion is shorter than broad, its breadth about equals that of the body, in ordinary contraction; its sides, in the region of the eyes, are somewhat swollen; the under surface is flattened, and has a deep excavation in front, semi-circular, or rather semi-elliptical, in outline, to receive the dorsal half of the siphon-tube, which fits into it closely.

The sides of the head, back of the eyes, have a rather prominent, transverse ridge, back of which the head suddenly narrows, to the neck. The transverse ridges curve backward slightly and meet on the dorsal side of the head, where they are less prominent. Three thin, lamelliform, erect folds of the skin extend backward from the transverse ridge, on each side of the head; of these the middle or lateral one is about in line with the lower eye-lid; the upper one is, at its origin, about midway between the latter and the median dorsal line, but its posterior edge bends downward and joins that of the one below; the lowest of the three is shorter and curves upward, and finally joins the middle one, at its posterior edge. These folds form, therefore, in connection with the transverse ridge, two well-defined lateral areas or facets, of delicate and probably very sensitive integument, placed just in front of the mantle-opening, on each side, where they must be bathed by the inflowing currents of water. It seems probable to me, therefore, that they are the seat of a special sense, analogous to, if not identical with, that of smell. They are, also, closely connected with the organs of hearing, and may be of some service in concentrating sound-vibrations. A small pore is situated within the lower facet.

The pupils are round and the eyes are large, though the opening between the lids is usually rather small, especially in alcoholic specimens. In these the aperture is usually contracted to a small obliquely transverse, irregular-triangular form, or even to a narrow oblique slit;

when more open the aperture is still usually somewhat angular; the anterior sinus is narrow and extends downward and forward.

The eye-lids form, when nearly expanded, an irregular oval, the longest diameter placed transversely and somewhat obliquely, while the narrow and deep sinus extends forward and somewhat downward. When partly closed (Plate XXIX, fig. 5) the opening between the lids generally becomes more oblong and sometimes approaches a triangular form.

The mantle is thick and very muscular; its anterior margin has a concave outline beneath, forming a slightly prominent angle on each side; from these angles it advances somewhat to the slight median dorsal angle, which projects forward but little, and does not form a distinct lobe, and sometimes it is hardly noticeable, even as an angle, the transverse outline of the edge on the dorsal side being, in that case, nearly straight, or advancing a very little in the middle.

The sessile arms are rather stout, tapering to acute tips. The dorsal arms are a little smaller and shorter than the others; the second and third pairs are nearly equal in size and length, the second often a trifle the longer; those of the fourth pair are usually intermediate in length between the first and second pairs.

All the sessile arms are stout and armed with similar suckers. Along their inner angles, outside the suckers, they are all similarly provided with marginal membranes, which rise to about the same height as the suckers, on each side. Just proximal to each sucker on the inner face of the arm, arises a thickened, transverse, muscular fold, that extends to the edge of the lateral membrane, which often recedes between their extremities, so as to have a scolloped outline.

The dorsal arms are a little shorter and decidedly smaller than the others. The two lateral pairs of arms are stoutest and longest, and nearly equal, sometimes one pair and sometimes the other, being longest. The ventral arms are a little longer than the dorsal and shorter than the lateral ones. The dorsal and upper-lateral arms are trapezoidal in section, with the inner face rather broad. The dorsal arms have a slightly elevated, median dorsal fold, commencing near the base and running to the tip. Those of the second pair have a broader, membranous fold on the lower-outer angle, along the whole length. Those of the third pair are stouter than the others, and much compressed laterally, with the outer surface rounded, close to the base, but becoming compressed and keeled farther out, and having a high median ridge along its middle region, becoming narrow toward the tip. The ventral arms are trapezoidal in section, with a narrow fold

along the outer angle, which is acute, while the ventral angle is rounded.

The tentacular-arms (Plate XXVIII, figs. 1*a*, 2) are long; when extended, in fresh specimens, they reach back beyond the base of the caudal fin. They are rather stout, rounded-trapezoidal along the peduncular portion; along the upper-outer angle a thin fold runs from the base to the tip, becoming a wide carina on the backside of the club; two less marked folds run along the inner angles, defining a narrow inner face, along the whole length, but on this face there are no suckers, except close to where it begins to expand into the broader face of the club; along the sides of the club, the marginal membranes become much wider, rising to a level with the suckers.

In the male of our species, one of the ventral arms (Plate XXVIII, figs. 3, 3*a*) is strongly hectocotylized, somewhat as in *Loligo*. But in this species it is the right arm, about as often as the left, that is modified. Toward the tip of the arm, for some distance, the pedicels of the suckers, especially of the outer row, become shorter, and the bases of the sucker-stalks become larger, broader, and transversely compressed, while the cups of the suckers themselves decrease rapidly, till they become very minute, and on a number of the most flattened and largest stalks, they are entirely abortive, in the case of the medium sized males, but, very close to the tip, they may again become normal. The inner row of suckers is more or less modified, in a similar manner; but fewer of the sucker stalks are affected, and these are, usually, not so extensively altered, though in the larger males many of them are commonly destitute of cups and have the same flattened form as those of the outer row, with which they are usually united along the median line of the arm, forming a zigzag ridge. In a very large male (J), with the right ventral arm modified, the alteration of the sucker-stalks becomes obvious at about the 45th sucker, and there are, beyond this, about 80 modified suckers, extending to the very tip; of these about 30, in the outer row, are represented only by the flat, lamelliform bases of the sucker-stalks, without cups; on the inner row, the small cups extend for about ten suckers farther than on the outer. The lamelliform processes are united medially in a zigzag line, along the entire tip. The modified part is about an inch in length. This arm is as long as its mate, (though in other specimens it is often shorter); but it is broader, stouter, and more blunt at tip, both the inner face and lateral membrane being increased in width. The younger males, 4 to 6 in. long, have the corresponding suckers less extensively modified, and the cups, though very much reduced in size, are usually present on all or nearly all the stalks.

The portion of the tentacles which bears suckers is always less than half the whole length. The relative size of the suckers varies greatly in both sexes, perhaps in connection with a periodical renewal of their horny rings.

The club is long and moderately broad, gradually widening from the peduncular part of the arm, and tapering at the end to a rather blunt, flattened and curved tip, which is strongly carinated on the outer side by a thin lamina. The suckers commence a short distance in advance of the expansion of the club. They are at first small, deep cup-shaped, and somewhat scattered, in two alternate rows, but all of these small ones have oblique rims, strongly denticulated on the outer margin with four or five long incurved teeth, while the inner edge is smooth. Of the small ones, before the commencement of the two median rows of large suckers, there are from ten to fifteen.

The middle region of the club is occupied by two rows of large suckers (fig. 7) and by a row of small marginal ones, on each side, alternating with the large ones. The uppermost of the two rows of large suckers contains one or two more suckers than the lower, and they are also larger. The number in the upper row is seven to nine, in the lower five to seven, the largest specimens having the greater number. Of these, the three to five middle ones in each row are decidedly the largest and have the edge of the marginal ring nearly smooth and even; at each end of each row the suckers diminish in size and the edge becomes denticulate, at first by the formation of narrow incisions, which leave broad, stout, blunt denticles; but as the suckers diminish in size these become longer, narrower and more acute; their inner margins remain smooth. The large suckers are broad and moderately deep, somewhat swollen below, and a little oblique. The marginal suckers are much smaller, shallower, more oblique, and have the entire rim finely and sharply denticulate, the denticles being longer and strongly incurved on the outer margin. Beyond the rows of large suckers there is, at first, a small group of sharply denticulate suckers, in four rows, resembling the marginal ones in form and size; but these rapidly decrease in size and are succeeded by eight crowded rows of very small suckers, with minute apertures, which occupy the entire face of the terminal section to the tip.

The suckers of the sessile arms are largest on the two lateral pairs, on which they are nearly equal, and the largest are about the same in size as those on the tentacular-club;* those of the ventral arms are smallest; those of the dorsal arms are intermediate in size between

* In the males the tentacular suckers are usually the smaller; in the females often the larger.

those of the lateral and ventral arms. The first few suckers (three to five), at the base of each arm, are smaller than those beyond, but increase regularly in size; they have the edge of the rim nearly entire, or with only a few blunt teeth on the outer margin; then follow about twelve suckers, of the largest size. These large suckers (Plate XXVIII, figs. 5, 5*a*) are deep, oblique cup-shaped, somewhat swollen in the middle, with oblique horny rims, which are entire on the inner margin, but on the outer have a large, strongly incurved, acute median tooth, on each side of which there are usually four or five shorter, flat, blunt teeth; but toward the base of the arms these are fewer and shorter, while distally they become more numerous, longer, and more acute, and often the edge is more or less denticulate nearly all around. The larger suckers are followed by a regularly decreasing series of thirty to forty smaller secondary ones (figs. 6, 6*a*), not counting the numerous very small ones, within one-third of an inch of the tip. These secondary suckers grade gradually into the large or primary ones, both in size and form; they are, however, armed with four or five very sharp incurved teeth, on the outer margin, of which the median one is longest, while the inner margin is usually entire. They are very oblique and one-sided in form. The membrane around the rim of all the suckers is thickened, but most so on the basal ones; it usually recedes behind the large median tooth, leaving there an emargination.

The outer buccal membrane is not very large; its inner surface is closely covered with lamelliform folds and wrinkles; its border is prolonged into seven acute angles, from which membranes extend to the opposite arms, going to the upper sides of the second and fourth pairs of arms; to the lower side of the third pair; but the seventh angle is in the median dorsal line, and the membrane from it bifurcates, one-half going to the inner side of each dorsal arm. Immediately around the jaws there is a circular, thickened, rugose oral membrane, with a strongly lobed edge, while its inner surface is radially wrinkled and covered with scattered rounded verrucæ. A plain fold intervenes between this and the outer buccal membranes.

The jaws are sharp and incurved at tip, reddish brown to brownish black in color, with the posterior borders of the laminæ whitish and translucent. The upper mandible has a much incurved tip, with the cutting edges regularly curved, and with a shallow notch at their bases, beyond which the anterior edges rise into a broad obtuse lobe or low tooth, by which the hardened and dark-colored part, as seen by transmitted light, has the form of a sharp angular tooth, but its

actual projection anteriorly is but slight, because the translucent edge beyond it rises to about the same level. The lateral-posterior borders of the frontal laminæ are sinuous and incurved in the middle; the palatine lamina is broad, with the posterior lateral edges incurved and sinuous.

The lower mandible has the extreme tip strongly incurved, forming a slight notch, close to the tip, below which the edges are slightly incurved or nearly straight, with a decided V-shaped notch at the base; the anterior edges, beyond the notch, form a triangular tooth of the inner laminæ, but this is obscured, unless viewed by transmitted light, by the outer alar laminæ, which rises at its anterior edge, which is translucent, nearly to a level with the tooth; the inner ends of the alæ are wider than the middle, and broadly rounded; the gular laminæ are short, narrowed posteriorly, with their inner edges incurved, and with a thickened, prominent ventral carina.

The jaws of a large specimen measure as follows: upper mandible, tip to posterior end of palatine lamina, 22^{mm}; to dorsal end of frontal lamina, 16; to posterior lateral edge of same, 9; to base of cutting edge, 5; inner edge of palatine lamina to dorsal end of frontal lamina, 17. Lower mandible, tip to inner end of alæ, 13^{mm}; to ventral notch of alæ, 4; to ventral notch of gular laminæ, 9; to posterior end of same, 16; to base of cutting edges, 5.

The buccal mass has, on the outer surface of the dorsal and lateral sides, a broad, thin, brown horny plate, with a notch posteriorly, in the median line.

The odontophore (Plate XXXVII, fig. 8), is remarkable for the length and sharpness of the teeth, especially of the central and outer rows. The median teeth have a long and very acute median denticle, with much shorter lateral ones. The inner lateral teeth have broad bases and a long and very sharp central denticle, with a much shorter lateral one, on the outside. The next to the outer lateral teeth are simple, slender and sharp. The outer lateral teeth are much longer, strongly curved, and very acute.

The pen (Plate XXVIII, fig. 4) is long and slender, with a slender midrib and strong marginal ribs; the anterior end is thin, broad pen-shaped, subacute; from very near the anterior end it tapers gradually backward to about the posterior fourth, where it becomes very narrow, apparently consisting only of the consolidated lateral ribs and midrib, the former showing on the ventral side a thin groove between them, the latter appearing as a slender ridge on the dorsal side. The posterior portion is narrow-lanceolate in form, with thin

edges, and a strong midrib, composed of the united marginal ribs of the anterior portion; the thin edges are incurved, so as to give a canoe-shaped form to this portion, and near the tip, the edges unite beneath into a short hood-like tip. Anteriorly the lateral ribs show two grooves on the ventral side, and appear to be composed of three united ribs.

The ground-color of a specimen taken by me, in 1870, at Eastport, Maine, when first caught, was pale bluish-white, with green, blue and yellow iridescence on the sides and lower surface; the whole body, head, and outer surfaces of arms and fins were more or less thickly covered with small, unequal, circular, orange-brown and dark brown spots, having crenulate margins; these spots were continually changing in size, from mere points, when they were nearly black, to spots 1^{mm} to $1{\cdot}5^{mm}$ in diameter, when they were pale orange-brown, becoming lighter colored as they expanded. On the lower side of body, head, and siphon the spots were more scattered, but the intervals were generally less than the diameter of the spots. On the upper side the spots were much crowded and in different planes, with the edges often overlapping, thus increasing the variety of the tints. Along the middle of the back the ground-color was pale flesh-color, with a distinct median dorsal band, along which the spots were more crowded and tinged with green, in fine specks. Above each eye there was a broad lunate spot of light purplish red, with smaller and much crowded brown spots. The upper surface of the head was deeply colored by the brown spots, which were here larger, darker, and more crowded than elsewhere, and situated in several strata. The under sides of the arms and fins were colored like the body, except that the spots were smaller and much less numerous. The suckers were pure white. The eyes were dark, blue-black, surrounded by an iridescent border.

The colors change constantly, when living or recently dead, by means of the continual contraction and dilation of the chromatophores. The different tints pass over the surface like blushes.

In specimens recently preserved in alcohol, the same pattern of coloration is usually visible. The dark dorsal band on the body and head, and the dark patches above the eyes, as well as smaller dark patches in front of the eyes, can be plainly seen. In these darker parts the chromatophores are much crowded, and have a purplish brown color, varying to chocolate-brown in specimens longer preserved. On other parts of the body the chromatophores are more scattered and usually reddish brown in color, with a circular or elliptical outline; when expanded, the larger ones are about 1^{mm} in diam-

eter. The under surfaces of the fins, siphon, head, and arms have fewer and smaller spots, and are, therefore, lighter colored, and appear nearly white when these spots are contracted.

A fresh specimen, caught in Casco Bay, in 1873, had the following proportions: Length of head and body, not including the arms, 221^{mm}; length of caudal fin, 86; breadth of fin, 90; diameter of body, 35; length of upper arms, 80; of second pair, 100; of third pair, 100; of the ventral pair, 90; of tentacular-arms, 182^{mm}.

Of our species, I have measured large numbers of specimens, preserved in different ways, and also fresh, and have found no great variation in the form and relative length of the caudal fin, among specimens of similar size and in similar states of preservation, nor do the sexes differ in this respect. The young, however, differ very decidedly from the large specimens in these respects. The modes of preservation also cause much of the variation in the proportions of fins and arms to the mantle. The two sexes are probably equally numerous, but in our collections the females usually predominate, and the largest specimens are usually females, though equally large males occur. In 31 measured specimens, in alcohol, from various localities and of both sexes, the average length, from tip of tail to dorsal edge of the mantle, was 176^{mm} (6·96 inches); from tip of tail to insertion of fin, 66^{mm} (2·60 inches); average proportion of fin to mantle-length, 1 : 2·68. Among these the proportions varied from as low as 1 : 2·48, in some of the larger ones (with mantle above 8 inches), up to 1 : 3·00, in the smaller ones (with the mantle less than 3 inches long).

The following tables are intended to illustrate the natural variation in the proportions, due mainly to age, and the accidental variations caused by differences in the modes of preservation and strength of the alcohol.

The specimens from Eastport, Me., designated G. H. I. R., were collected at one time, in midsummer, and preserved in the same way, in alcohol of moderate strength, repeatedly changed; at the present time the strength of the alcohol is about 80 per cent. They are in good condition, moderately firm and not badly contracted. Those designated as D. E. F. N. O. P., were also collected at one time, in August, and preserved together. They are in fair condition, but not so well preserved as the former lot. Those numbered ii to xiv were preserved together, about the last of July. They were placed in strong alcohol and are hard and badly contracted. J. K. and L. were preserved together, but were originally found dead on the beach and in a relaxed state. They are only moderately contracted by the alcohol.

Measurements of Ommastrephes illecebrosa (in inches).

	O ♀	P ♀	D ♀	E ♀	J ♂	I ♂	R ♂	W ♂	Fresh.
Tail to tip of dorsal arms,	13·40	13·00	12·75	10·50	13·50	10·50	10·50	8·25	--
Tail to tip of second pair arms,	14·20	13·70	--	--	14·30	10·80	11·10	--	--
Tail to tip of third pair arms,	14·20	13·70	13·25	11·00	14·20	11·00	11·20	--	--
Tail to tip of fourth pair arms,	13·10	13·60	--	--	13·40	10·60	11·00	--	--
Tail to tip of tentacular-arms,	16·50	17·50	15·5	12·00	15·50	12·20	12·50	--	--
Tail to base of dorsal arms,	10·00	9·40	9·00	7·90	10·00	8·30	8·20	6·50	8·84
Tail to center of eye,	9·30	8·90	8·25	7·35	9·50	7·75	7·70	--	--
Tail to edge of mantle, above,	8·60	8·00	7·75	7·10	8·70	7·50	7·20	5·70	--
Tail to edge of mantle, below,	8·20	7·50	7·30	--	8·10	7·15	6·65	5·38	--
Tail to insertion of fin,	3·30	3·20	3·10	2·75	3·50	2·90	2·80	2·10	3·44?
Breadth of fin,	4·20	4·30	4·25	3·78	5·15	3·80	3·90	2·65	3·60
Distance between lateral insertions,	--	--	·50	·40	·65	·45	--	--	--
Front edge, outer angle to insertion,	2·20	2·20	2·00	1·90	2·50	2·80	2·10	1·45	--
Back edge, outer angle to tip of tail,	3·30	3·25	3·15	2·90	3·50	3·00	2·90	2·00	--
Circumference of body,	4·80	4·80	--	--	6·50	4·30	4·00	--	--
Breadth of body,	1·70	1·60	--	--	2·15	1·30	1·40	1·10	1·40
Breadth of head at eyes,	1·60	1·50	1·35	1·15	1·65	1·20	1·30	1·00	--
Breadth of eye-opening,	·40	·45	·35	--	·36	·20	·23	·25	--
Breadth of siphon at bridle,	·75	·70	·65	·55	·78	·60	·55	--	--
Length of head, mantle to base of dorsal arms,	1·40	1·40	1·25	·80	1·30	·80	1·00	·80	--
Length of dorsal arms,	3·75	3·60	3·25	2·70	2·65	2·20	2·43	1·75	3·20
Length of 2d pair,	4·30	4·20	4·00	3·15	4·40	2·70	3·12	2·25	4·00
Length of 3d pair,	4·10	4·25	4·00	3·00	4·55	2·67	3·15	2·25	4·00
Length of 4th pair,	3·60	3·80	3·50	2·86	3·80	2·43	2·75	2·00	3·60
Length of tentacular-arms,	6·80	8·00	6·50	4·00	5·80	4·00	4·10	4·50	7·28
Length of club,	3·30	3·50	2·75	1·85	2·55	1·75	1·90	1·30	--
Breadth of dorsal arms,	·35	·36	·28	·25	·35	·30	--	·20	--
Breadth of 2d pair,	·45	·44	·35	·30	·45	·35	--	·25	--
Breadth of 3d pair,	·45	·44	·35	·28	·50	·35	--	·25	--
Breadth of 4th pair,	·44	·42	·32	·30	·45	·35	--	·25	--
Breadth of tentacular-arms,	·25	·28	·30	·30	·28	·20	--	·17	--
Breadth of club,	·30	·30	·22	·18	·25	·22	--	--	--
Front to back of 3d pair,	·65	·60	·50	·40	·65	·45	--	--	--
Diameter of Suckers:									
Largest on tentacular-arms,	·18	·17	·15	·11	·18	·10	·13	--	--
Largest on 3d pair,	·18	·16	·14	·11	·21	·14	·14	--	--
Largest on ventral arms,	·11	·11	·10	·09	·11	·09	·07	--	--
Proportions:									
Length of fin to mantle length, 1:	2·60	2·50	2·50	2·58	2·48	2·58	2·57	2·71	--
Breadth of fin to mantle length, 1:	2·04	1·86	1·82	1·87	1·69	1·97	1·84	2·15	--
Length* to breadth of fin, 1:	1·27	1·34	1·37	1·37	1·46	1·30	1·39	1·26	--
Length of head to mantle, 1:	6·14	5·70	6·20	8·87	6·70	9·30	7·20	7·12	--

The same specimens, included both in this and the following tables, show small differences in their measurements (made at different times), due partly to the different degrees of extension employed in measuring them, and partly to the fact that the alcohol had been changed, and its strength altered.

* The length of the fin, in these tables, means the distance from the lateral insertions to the tip of the tail, which is somewhat less than the extreme length.

Measurements of Ommastrephes illecebrosa, males, (in inches).

Locality.	Vineyard Sd.	Vineyard Sd.	Eastport.	Eastport.	Eastport.	Vineyard Sd.	Mass. Bay.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Cape Cod.	Newport.
Sex and designation,	♂ J	♂ L	♂ H	♂ I	♂ R	♂ M	♂ W	♀ ii	♀ iii	♂ iv	♂ v	♂ vi	♂ vii	♂ viii	♂ ix	xi	♂ xii	♀ xiii	♀ xiv	10280
End of body to edge of mantle, above,	8·70	8·50	7·80	7·45	7·10	6·80	6·15	4·00	4·40	5·25	4·05	4·15	6·70	5·55	6·70	5 60	5·80	4·15	4·10	2·70
End of body to edge of mantle, beneath,	8·10	8·00	7·30	7·10	6·70	6·35	6·00	3·70	4·00	4·80	3·90	4·00	6·30	5·25	6·15	5·40	5·70	3·90	3·85	2·60
End of body to origin of fin,	3·50	3·30	3·00	2·90	2·80	2·70	2·30	1·45	1·60	2·00	1·45	1·50	2·60	2·10	2 60	2·20	2·20	1·50	1·40	·90
End of body to center of eye.	9·50	9·30	8·20	7·80	7·50	7·10	6·80	4·35	4·70	5·45	4·10	4·40	7·10	5·90	6·90	5·90	6·25	4 30	4·20	3·00
End of body to base of dorsal arms,	10·00	10·30	9·00	8·20	8·20	7·80	7·10	4·50	5·00	5·75	4·50	4·80	7·70	6·30	7·70	6·50	6·60	4·60	4·55	3·15
Eye to tip of dorsal arms,	4·50	4·15	3·05	2·60	2·95	3·30	2·70	1·35	1·65	2·05	1·35	1·50	2·90	2·10	3·00	2·50	2·35	1·40	1·40	1·30
Eye to tip of 2d pair of arms.	4·90	4·80	3·50	2·95	3·20	3·60	3·00	1·45	1·85	2·30	1·50	1·70	3·10	2·35	3·30	2·80	2·65	1·65	1·50	1·65
Eye to tip of 3d pair of arms,	4·95	4·90	3·30	2·95	3·40	3·80	2·95	1·50	1·80	2·20	1·45	1·70	3·00	2·35	3·10	2·60	2·40	1·70	1·55	1·55
Eye to tip of 4th pair of arms,	4·50	4·10	3·10	2·90	3·20	3·35	2·70	1·40	1·70	2·20	1·35	1·50	2·90	2·00	2·95	2·50	2·25	1·60	1·30	1·25
Eye to tip of tentacular-arms.	6·50	5·70	4·40	4·00	4·20	4·85	3.70	1·90	2·40	2·75	2·15	2·20	4·20	3·30	5·40	3·60	3·10	2·30	2·00	2·25
Breadth of head across eyes,	1·60	1·30	1·40	1·15	1·30	1·00	1·20	·70	·80	·90	·75	·80	1·20	1·00	1·10	1·00	·90	·70	·70	·58
Breadth of head in front of eyes,	1·60	1·30	1·25	1·05	1·20	1·00	1·00	·60	·70	·80	·70	·65	1·05	·90	1·00	·90	·85	·70	·60	·46
Breadth of body,	2·10	1·75	1·55	1·40	1·35	1·20	1·05	·80	·80	·90	·80	·70	1·10	·95	1·15	1·15	1·00	·80	·70	·60
Breadth of caudal fins,	5·15	4·35	4·30	3·60	3·75	3·70	3·00	1·95	2·20	2·60	1·90	2·05	3·30	2·70	3·40	2·75	2·70	2·05	1·90	1·35
Circumference of body,	6·30	5·60	4·80	4·30	4·05	3·90	3·10	2·10	2·20	2·95	2·40	2·40	3·20	2·90	3·80	3·30	3·15	2·25	2·20	--
Length of tentacular-club,	2·55	2·50	1·89	1·60	1·85	2·30	1·60	·90	1·10	1·20	·95	1·00	1·65	1·40	2·10	1·50	1·40	·90	·95	1·15
Diameter of largest suckers of club,	.17	·14	·12	·11	·13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	·01
Of largest suckers on 3d pair arms,	·20	·16	·15	·15	·14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ratio of fin to length of mantle, 1:	2·48	2·57	2·60	2·57	2·53	2·51	2·67	2·75	2·75	2·62	2·80	2·76	2·58	2·64	2·58	2·54	2·63	2·76	2·85	3·00
Breadth of fin to length of mantle, 1:	1·69	1·95	1·81	2·10	1·90	1·83	2·05	2 05	2·00	2·02	2·15	2·02	2·03	2·05	1·97	2·03	2·15	2·02	2·16	2·00

Measurements of Ommastrephes illecebrosa, females, (in inches).

Locality.	Eastport.	Eastport.	Vineyard Sd.	Eastport.	Eastport.	Eastport.	Eastport.	Eastport.	Casco Bay.	Casco Bay.	Newfoundl'd.	Maine.	Halifax.	Cape Cod.
Sex and designation,	♀ D	♀ E	♀ K	♀ O	♀ N	♀ G	♀ P	♀ F	♀ U	♀ T	♀ Q	♀ X	♀	♀ x
End of body to edge of mantle, above,	7·80	7·15	9·50	8·70	8·70	8·60	8·10	7·80	7·45	6·85	8·80	5·55	8·70	6·25
End of body to edge of mantle, beneath,	7·30	7·00	8·70	8·30	8·05	8·10	7·60	7·20	6·85	6·50	8·40	5·30	7·90	6·10
End of body to origin of fin,	3·10	2·80	3·70	3·40	3·50	3·40	3·20	3·10	3·00	2·85	3·50	2·15	3·60	2·40
End of body to center of eye,	8·25	7·60	10·00	9·10	9·00	9·30	9·10	8·30	7·98	7·30	9·60	5·80	9·70	6·70
End of body to base of dorsal arms,	9·00	8·00	10·50	9·90	9·70	10·00	9·85	8·70	8·20	7·80	10·50	6·20	10·50	7·20
Eye to tip of dorsal arms,	4·00	3·50	4·80	4·30	4·45	4·20	4·20	3·30	3·00	2·30	4·70	--	5·60	2·65
Eye to tip of 2d pair of arms,	4·55	3·70	5·60	4·75	4·95	4·40	4·70	3·90	3·50	3·25	5·10	2·55	6·30	2·65
Eye to tip of 3d pair of arms,	4·50	3·60	5·40	4·75	4·65	4·30	4·75	3·65	3·45	3·30	5·15	2·50	6·20	2·80
Eye to tip of 4th pair of arms,	4·30	3·20	5·40	3·80	4·40	4·20	4·75	3·60	3·20	3·20	5·00	--	6·15	2·70
Eye to tip of tentacular-arms,	7·00	4·60	8·10	7·00	6·00	5·50	8·00	6·10	4·80	4·95	7·00	3·40	10·50	3·70
Breadth of head across eyes,	1·35	1·15	1·30	1·60	1·50	1·55	1·30	1·20	1·35	1·10	1·90	1·00	1·50	1·05
Breadth of head in front of eyes,	--	--	1·45	1·40	1·50	1·50	1·30	1·10	1·25	1·00	1·65	--	--	1·00
Breadth of body,	--	--	1·72	1·60	1·90	1·85	1·00	1·20	1·50	1·25	2·35	--	--	1·20
Breadth of caudal fins,	4·25	3·85	5·50	4·15	4·85	5·00	4·30	4·00	4·05	3·70	5·50	2·85	5·30	3·10
Circumference of body,	--	--	5·65	4·70	5·25	5·80	4·75	3·90	4·40	3·70	6·80	--	--	3·50
Length of tentacular-club,	2·75	1·85	2·85	3·20	2·75	2·60	3·15	2·00	2·00	1·90	2·70	1·55	4·20	1·55
Diameter of largest suckers of club,	·15	·11	·16	·18	·18	·20	·17	·12	--	--	·17	--	·19	--
Of largest suckers on 3d pair arms,	·14	·11	·16	·18	·20	·19	·15	·13	--	--	·18	--	·20	--
Ratio of fin to length of mantle, 1 :	2·51	2·55	2·56	2·56	2·46	2·52	2·53	2·51	2·48	2·40	2·51	2·58	--	2·60
Breadth of fin to length of mantle, 1 :	1·85	1·85	1·72	2·09	1·80	1·72	1·88	1·95	1·83	1·85	1·60	1·95	--	2·01

Coast of Rhode Island (Verrill) to Cumberland Gulf (Kumlein). Abundant from Cape Cod to Newfoundland. Newport, R. I. (U. S. Fish Com.) Vineyard Sd., Mass., rare, large in winter, small in May (V. N. Edwards).

Ommastrephes illecebrosa.—Specimens examined.

No.	Locality.	When Collected.	Received from.	Specimens. No.	Sex.
10280	Newport, R. I.	1872	U. S. Fish Com.	1	young.
10027, J.	Vineyard Sound.	Nov. 2, 1876	V. N. Edwards	1	♂, left-hand.
10027, K.	" "	" "	" "	1	♀
10027, L.	" "	" "	" "	1	♀
M.	" "	May, 1876	" "	1	♂, r.-hand.
W.	Provincetown, Mass.	July, 1879	U. S. Fish Com.	1	♂, fig'd.
--	" "	" "	" "	9	♂
--	" "	" "	" "	5	♀
--	" "	" "	" "	3	young.
--	" "	" "	" "	28+	dupl.
--	Salem, Mass.	Oct. 25, 1873	J. H. Emerton	1	♀
--	Gloucester, Mass.	1878	U. S. Fish Com.	1	young.
S. T. U.	Casco Bay, Me.	1873	U. S. Fish Com.	3	♀
X.	Off Seguin I., Me. (50 fath.)	1879	(lot. 517) U.S.F.C.	1	♀ young.
--	Mt. Desert, Me.	1860	A. E. Verrill	50+	large.
--	Off Cashe's Ledge.	1873 (loc. 21)	U. S. Fish Com.	1	mutilated.
9693, G.	Eastport, Me.	1870	A. E. Verrill	1	♀, large.
9693, H. I.	" "	"	" "	2	♂, left-hand.
9693, R.	" "	"	" "	1	♂, r.-hand.
D. E. F.	" "	1872	U. S. Fish Com.	3	♀, large.
N. O. P.	" "	"	" "	3	♀
--	" "	"	" "	1	young.
--	Halifax, N. S.	J. R. Willis	Smithsonian	1	young.
10028	" "	J. M. Jones	J. M. Jones	1	♀, large.
10278, Q.	Newfoundland.	" "	" "	1	♀, large.
--	Cumberland Gulf.	L. Kumlein	Nat. Museum	1	mutilated.

Several of the smaller specimens, included in this list, are so young that it is impossible to determine their sex with certainty, without dissection. The hectocotylization of the ventral arm in the male is scarcely recognizable in those with the mantle less than 4 inches long.

The Mediterranean form, usually identified with the *var. b*, of *Loligo sagittata* Lamarck, 1799,* is closely related to our species, but if the published figures and descriptions can be relied upon, it can hardly be identical, as D'Orbigny and other writers have considered it. The American form has a more elongated body, with a differently shaped caudal fin, which is relatively shorter than the best authors attribute to *O. sagittatus*. The figure given by Verany is, however, an exception in this respect, for in it the body is represented about as

* It seems more probable, however, that Lamarck's description applied rather to *O. Bartramii* (Les. sp.) of the Gulf Stream region. Blainville and others have thus applied it, correctly, as I believe.

long as in some of our larger specimens.* It should be remarked, however, that Lesueur's figure of *O. illecebrosa* shows the body too small and too short in proportion to the size of the fin, and the fin wrong in shape and occupying more than half the length of the mantle; the proportions of the arms are also erroneous. But Lesueur explains these defects by his statement that the figures were hasty sketches made for the sake of preserving the colors, and that he saved a specimen by which to correct, afterwards, his drawings and description, but the specimen saved turned out to be *L. pavo*, so that the original sketches were published without correction. Tryon's figure 342 is a poor copy of one of Lesueur's, without credit.

If the European form be really identical with the American, its distribution is very anomalous, for while the former is a southern European form, inhabiting the Mediterranean and scarcely extending north of the southern waters of Great Britain, where it appears to be rare, our species is strictly a northern, cold water form, rarely found south of Cape Cod, even in winter. Its range extends quite to the Arctic Ocean.

Notes on Habits.

When living, this is a very beautiful creature, owing to the brilliancy of its eyes and its bright and quickly changing colors. It is also very quick and graceful in its movements. This is the most common 'squid' north of Cape Cod, and extends as far south as Newport, R. I. It is very abundant in Massachusetts Bay, the Bay of Fundy, and northward to Newfoundland. It is taken on the coast of Newfoundland in immense numbers, and used as bait for cod-fish. It occurs in vast schools when it visits the coast, but whether it seeks those shores for the purpose of spawning or in search of food is not known. I have been unable to learn anything personally in regard to its breeding habits, nor have I been able to ascertain that anyone has any information in regard either to the time, manner, or place of spawning. At Eastport, Me., I have several times observed them in large numbers, in midsummer. But at that time they seem to be wholly engaged in the pursuit of food, following the schools of herring, which were then in pursuit of shrimp (*Thysanopoda Norvegica*), which occur in the Bay of Fundy, at times, in great quantities, swimming at the surface. The stomachs of the squids taken on these occasions were distended with fragments of *Thysanopoda*, or with the flesh of the herring, or with a mixture of the two, but their reproduc-

* According to Jeffreys (Brit. Conch., V, p. 129, pl. 5) the English *O. sagittatus* has the fin "from $\frac{2}{5}$ to nearly $\frac{1}{2}$ the length of the mantle;" and the form of the pen, as figured by him, is different from that of our species.

tive organs were not in an active condition. The same is true of all the specimens that I have taken at other localities in summer. From the fact that the oviducts are small and simple, and the nidamental glands little developed, I believe that it will eventually prove that this species discharges its eggs free in the ocean, and that they will be found floating at the surface, either singly or in gelatinous masses or bands, not having any complicated capsules to enclose them. Nothing is known as to the length of time required by this species to attain its full size. It probably lives several years.

This squid is an exceedingly active creature, darting with great velocity backward, or in any other direction, by means of the reaction of the jet of water which is ejected with great force from the siphon, and which may be directed forward or backward, or to the right or left, by bending the siphon. Even when confined in a limited space, as in a fish-pound, it is not an easy matter to capture them with a dip-net, so quick will they dart away, to the right and left. When darting rapidly the lobes of the caudal fin are closely wrapped around the body* and the arms are held tight together, forming an acute bundle in front, so that the animal, in this condition, is sharp at both ends, and passes through the water with the least possible resistance. Its caudal fin is used as an accessory organ of locomotion when it slowly swims about, or balances itself for some time nearly in one position in the water.

The best observations of the modes of capturing its prey are by Messrs. S. I. Smith and Oscar Harger, who observed it at Provincetown, Massachusetts, among the wharves, in large numbers, July 28, 1872, engaged in capturing and devouring the young mackerel, which were swimming about in 'schools,' and at that time were about four or five inches long. In attacking the mackerel they would suddenly dart backward among the fish with the velocity of an arrow, and as suddenly turn obliquely to the right or left and seize a fish, which was almost instantly killed by a bite in the back of the neck with their sharp beaks. The bite was always made in the same place, cutting out a triangular piece of flesh, and was deep enough to penetrate to the spinal cord. The attacks were not always successful, and were sometimes repeated a dozen times before one of these active and wary

* This position of the fins is well shown in Plate 26, fig. 341, of Binney's edition of Gould's Invertebrata of Massachusetts. This figure was probably drawn by Mr. Burkhardt from living specimens formerly kept in Cutting's Aquarium, in Boston, about 1860 to 1862. This figure is very good, in most respects, except that the clubs of the tentacles have been confounded with the ventral pair of the sessile arms, and thus the suckers are made to continue along the whole length of the tentacles.

fishes could be caught. Sometimes, after making several unsuccessful attempts, one of the squids would suddenly drop to the bottom, and, resting upon the sand, would change its color to that of the sand so perfectly as to be almost invisible. In this position it would wait until the fishes came back, and when they were swimming close to or over the ambuscade, the squid, by a sudden dart, would be pretty sure to secure a fish. Ordinarily, when swimming, they were thickly spotted with red and brown, but when darting among the mackerel they appeared translucent and pale. The mackerel, however, seemed to have learned that the shallow water was the safest for them, and would hug the shore as closely as possible, so that in pursuing them many of the squids became stranded, and perished by hundreds, for when they once touch the shore they begin to pump water from their siphons with great energy, and this usually forces them farther and farther up the beach. At such times they often discharge their ink in large quantities. The attacks on the young mackerel were observed mostly at or near high-water, for at other times the mackerel were seldom seen, though the squids were seen swimming about at all hours; and these attacks were observed both in the day and evening.

It is probable, from various observations, that this and other species of squids are partially nocturnal in their habits, or at least are more active in the night than in the day. Those that are caught in the pounds and weirs mostly enter in the night, evidently while swimming along the shores in 'schools.' They often get aground on the sand-flats at Provincetown, Massachusetts, in the night. On the islands in the Bay of Fundy, even where there are no flats, I have often found them in the morning, stranded on the beaches in immense numbers, especially when there is a full moon, and it is thought by many of the fishermen that this is because, like many other nocturnal animals, they have the habit of turning toward and gazing at a bright light, and since they swim backwards, they get ashore on the beaches opposite the position of the moon. This habit is also sometimes taken advantage of by the fishermen, who capture them for bait for cod-fish; they go out in dark nights with torches in their boats, and by advancing slowly toward a beach, drive them ashore.

They are taken in large quantities in nets and pounds, and also by means of 'jigs' thrown at random into the 'schools' and quickly drawn through them. They are also sometimes taken by lines, adhering to the bait used for fishes.

Their habit of discharging an inky fluid through the siphon, when irritated or alarmed, is well known. The ink is said to have caustic and irritating properties.

This squid, like the *Loligo*, is eagerly pursued by the cod and many other voracious fishes, even when adult. Among its enemies while young, are the full grown mackerel, who thus retaliate for the massacre of their own young by the squids. The specimens observed catching young mackerel were mostly eight to ten inches long, and some of them were still larger.

From the rapidity with which the squids devour the fish that they capture, it is evident that the jaws are the principal organs used, and that the odontophore plays only a subordinate part in feeding. This is confirmed by the condition of the food ordinarily found in the stomach, for both the fishes and the shrimp are usually in fragments and shreds of some size, and smaller creatures, like amphipods, are often found entire, or nearly so; even the vertebræ and other bones of herring are often present. On the other hand, in some specimens, the contents of the stomach are finely divided, as if the odontophore had been used for that purpose.

Notes on the Visceral Anatomy.

PLATE XXXVIII, FIGURE 2. PLATE XXXIX, FIGURE 2.

This species, in common with others of the same genus, is very different from *Loligo Pealei* in the form and structure of many of its internal organs. The branchial cavity is larger and the gills (*g, g*) originate farther back and are much larger than in *Loligo*, their length being about two-fifths the entire length of the body; they originate back nearly at the middle of the body. The liver (*l, l*) is much larger and more conspicuous, consisting of two large, oblong, lateral lobes or masses, closely united together in the median plane, with a groove along the dorsal side, in which lies the œsophagus. The ink-bag (*i*) is elongated-pyriform, with a silvery luster externally, but blackish when filled with the 'ink.' The size and form of the stomach and its cœcal lobe (*s, s'*) vary greatly according to their degree of distention with food. When well filled they are large, thin, saccular, and more or less pyriform; the cœcal lobe extending back nearly to the end of the body. The intestine (*h*) has two spatulate papillæ, one on each side of the anal orifice.

The heart (*H*) is large, somewhat irregular, and unsymmetrical, with four points, the two lateral continuous with the afferent vessels

(*bo*) of the gills; the anterior passing into the anterior aorta (*ao*); the posterior, median one, continuous with the posterior aorta, gives off, first a small ventral branch, which supplies the reproductive organs, and then later a median ventral artery (*o*), going to the mantle; while much farther back it divides into two branches (*o'*, *o'*) which supply the sides of the mantle and caudal fin. The branchial auricles (*au*) are large and ovate, with a small round capsule at the posterior end.

The urinary organs or 'kidneys' (*r*, *r*) are voluminous, lobulated organs, intimately connected with the venæ cavæ, and mostly situated below and in front of the heart, but there is a more compact glandular portion (*r'*) extending, as usual, backward along each of the posterior venæ cavæ (*vc''*) in the form of a long pyriform gland. Just in front of the bases of the gills, on each side, there is a circular opening (*u*) through the peritoneal membrane, which probably gives exit to the urinary excretions.

The reproductive organs of the female, however, present the greatest divergence from *Loligo*, and allied forms. Instead of having a single large oviduct, on the left side only, and opening far forward, we find, in this genus, two small oviducts (*od*) symmetrically placed and opening much farther back. Moreover, instead of the large and very conspicuous, unsymmetrical nidamental glands, situated in front of the heart, as in *Loligo*, we find in *Ommastrephes* much smaller and simpler glands (*xx*) situated much farther back, side by side, near the median line.

The ovary (*ov*) is a long, pyriform, lobulated organ; its anterior end is attached to the posterior end of the stomach, and is divided into several short lobes, which clasp the end of the stomach; its small posterior end extends backward into the concavity of the hooded portion of the pen (*p''*).

The spermary or testicle of the male (Plate XXXVIII, fig. 2, *t*) occupies the same position as the ovary; it is a more compact organ, with a smoother surface, and the anterior lobes are longer and narrower and extend farther forward along the sides of the stomach. The prostate gland and other male organs resemble those of *Loligo* (see Plate XL, figures 1, 2).

It must be borne in mind, however, that none of the specimens examined were in their breeding season. Consequently the reproductive organs were all much smaller and less conspicuous than they would have been in breeding individuals. This is particularly the case with the ovaries and spermaries, but the same remark would

also apply to the nidamental glands, which might assume a different form, as well as greater volume, at the breeding season.

The specimens dissected had all been preserved in alcohol, which, also, would cause these organs to appear smaller than is natural.

Additional note on distribution.—After the previous pages were printed, additional specimens of this species were obtained, extending its range much farther southward, in the deep water, near the edge of the Gulf Stream. Although we cannot be certain that specimens thus caught in the trawl were living at the bottom, owing to the possibility of their entering it during its ascent, it is very probable that they do actually inhabit those depths. This is rendered more probable by the fact that we found adult specimens in the stomachs of fishes (*Lophius*), taken at stations 865 and 893. The most southern specimens known were taken by Mr. A. Agassiz on the "Blake," off Cape Hatteras, in 263 fathoms.

Additional Specimens Examined.

Locality.	Fath.	When Coll'd.	Rec'd. From.	Specimens. No. Sex
865. N. L. 40° 05′; W. Lg. 70° 23′	65	1880	U. S. F. Com.	1 ad.
893. N. L. 39° 52′ 20″; W. Lg. 70° 58′	372	1880	" "	1 ad.
CCCXXXII, N. L. 35°45′30″; W. Lg. 74° 48′	263	1880	"Blake" exp.	3 ♀ ad.

Sthenoteuthis megaptera Verrill.

This volume, p. 223, plate 21, figs. 1–9, Feb., 1880.

PLATE XXI. PLATE XXVII, FIGURE 6. PLATE XLV, FIGURES 5, 5*a*.

Since printing the description of this species, in the first part of this volume, when only two examples were known, some additional specimens have been obtained.

The most important of these consists of the tentacular club and the pharynx, with the jaws and odontophore complete (Plate XLV, fig. 5). These are from a specimen, of which the head and arms were found in the mouth of a cod-fish, on the eastern part of George's Bank, by Manuel D. Mitchel, and were by him presented to the U. S. Fish Commission. The portions of the specimen not saved were used as bait for cod. The arms were described as 18 inches long.

The part of the tentacular club in my possession, which does not include the proximal portion, is 175^{mm} long, 17 broad, in the middle; the distal portion, beyond the large suckers, is 62 long, breadth of its sucker-bearing face, 8; from front to back, including width of dorsal keel, but not the suckers, 18; diameter of largest suckers, 12, of horny rings, 11; of aperture, 8; height of horny ring, outer side,

including teeth, 6·5; length of pedicels, 5; distance between pedicels, 15mm. The large suckers agree very well with those described and figured from the type-specimen (Pl. XXI, fig. 9); this portion of the club had nine of these large suckers in each row; their pedicels arise from the middle of deep squarish depressions, between which run thick transverse ridges, which bear the smaller marginal suckers toward their outer ends, and then support the marginal membrane. A part of the large suckers have retained their horny rings, but all the marginal and small distal suckers have lost them. The horny rings of the large suckers (fig. 5*a*) are oblique, much higher on the outer than on the inner side; the edge bears about 28 sharp, incurved, well-separated, unequal teeth; of these the largest is at the middle of the outer edge; another smaller one, but larger than its fellows, is at the middle of the inner edge; two others, in size similar to the last, occupy the middle of the lateral edges; thus the edge is divided into four equal parts, by the four larger teeth, between which there are five or six smaller, very acute teeth, separated by spaces greater than their breadth. The horny rings are amber-brown, the teeth are golden yellow at tip. The distal portion of the club is compressed, with the face narrow and tapering, but with an elevated dorsal keel; it bears four crowded rows of small, pedicelled suckers, the two rows on one side of the median line being composed of very much smaller suckers than the other two. At the very tip of the club there is a round cluster of small, smooth suckers, as in *Architeuthis*. The buccal mass is 52mm in length and 42 in diameter. A thick buccal membrane, covered with low, irregular verrucæ, surrounds the jaws. The jaws are sharp and strong; their exposed portions are black, the alæ reddish brown. The beak of the upper jaw is long, strongly incurved, acute, its cutting edge regularly curved, with a deep notch at its base, from which a well-defined groove runs downward. The lower jaw is sharp, its cutting edge is most concave near the tip, below which it is nearly straight, sides covered with fine radiating lines; basal notch broad, shallow, angular; beyond the notch there is a broad, low angular tooth. The surface of the fleshy palate is covered with low rounded verrucæ. The odontophore is broad, with sharp, pale amber-colored teeth, which agree well with those of the original specimen (Plate XXI, figures 3–7); outside of the lateral teeth there is a narrow, raised, chitinous ridge, apparently not divisible into plates.

Another specimen, consisting of the buccal mass and jaws, but without the odontophore, was presented to the U. S. Fish Commis-

sion (lot 797) by Captain Chas. Anderson and crew of the schooner "Alice G. Wunson," of Gloucester, Mass.

The jaws of this were slightly larger than in the one just described. They agree well in nearly every respect, but the notch at the base of the lower mandible is narrower and the tooth beyond it broad and rounded.

Measurements of jaws, in millimeters.

Number of Lot.	810	797
Upper jaw, tip to bottom of notch,	12	13
Transverse breadth, at notches,	9	10
Tip to end of frontal lamina,	38	41
Lower jaw, tip to bottom of notch,	11	13
Tip to notch of mentum,	11	14
Tip to ventral end of gular lamina,	--	25
Mentum to inner end of lateral alæ,	31	36
Breadth of lateral alæ,	15	15
Breadth of odontophore, across face,	5·5	

A fifth specimen, received in lot 879, Oct., 1880, consists of two of the sessile arms, but the suckers have lost their horny rings, so that the identification cannot be very positive. The largest arm, which is not quite entire, is 255^{mm} long, and 23^{mm} in diameter, at the larger end. It was taken from the stomach of a cod, on the Grand Banks, and presented to the U. S. Fish Commission by the Captain and crew of the schooner "Otis P. Lord."

Specimens Examined.

Lot.	Locality.	Fath.	When rec'd.	Name of vessel.	Received from.	Specimens.
	C. Sable, N. S.	Beach.			Halifax Mus'm	1, entire.
	Sable I. Bank	280–300	Sept., 1878.	A. H. Johnson	U.S. Fish Com.	1, jaws, etc.
810	George's Bank	Cod stom.	Aug., 1880.	Sultana	"	1, jaws & arm.
797	E. slope G.'s B.	Cod stom.	Aug., 1880.	Al. G. Wunson	"	1, jaws.
879	Grand Banks	Cod stom.	Oct., 1880.	Otis P. Lord	"	1, arms.

Sthenoteuthis Bartramii Verrill.

Loligo sagittatus (*pars*) Lamarck, 1799; Anim. sans Vert., vii, p. 665.

Loligo Bartramii Lesueur, Journ. Phil. Acad., I, vol. ii, p. 90, plate 7, 1821.

Blainville, Dict. Sci. Nat., xxvii, p. 141, 1823.

Loligo sagittatus Blainv., Dict. Sci., Nat., xxvii, p. 140.

Ommastrephes Bartramii D'Orb., Voy. Amer. Merid., Moll., p. 55, 1838 (t. Gray); Céph. Acétab., pl. 2, figs. 11–20.

Gray, Catal. Moll. Brit. Mus., Cephal. Antep., p. 62, 1849.

Verrill, Invert. Vineyard Sound, etc., p. 341 [635], 1874 (*non* Binney, in Gould, Invert. Mass.)

Tryon, Man. Conch., i, p. 180, pl. 80, figs. 361, 362 (from D'Orb.).

Sthenoteuthis Bartramii Verrill (continued).

Sthenoteuthis Bartramii Verrill, this volume, p. 223, Feb., 1880; Amer. Journ. Sci., xix, p. 289, Apr., 1880.

Ommatostrephes Bartramii Steenstrup, Oversigt Kongl. D. Vidensk. Selsk. Forhandl., 1880, (received Aug.), auth. sep. copy, p. 9, fig. 2, p. 11. fig. 3, p. 19.

Body cylindrical, elongated, slender, tapering but little in front of the fin; anterior edge of mantle with a very slight, median dorsal angle. Caudal fin short and transversely rhomboidal, with the outer angles acute, posterior angle obtuse, and the front edges rounded and projecting forward beyond the insertion. Length of fin (from insertion) to its breadth, as 1 : 2; length of fin to mantle, as 1 : 2·80, in a young female specimen with the body 3·25 inches long. Head short, as broad as the body; eye-opening angular, higher than long, with a narrow oblique sinus. Nuchal frills nearly as in *O. illecebrosa*, consisting of a low, transverse, undulated ridge extending around both sides to the dorsal line, and with three raised longitudinal membranes on each side. Siphon large, sunken in a deep pit; anterior border of the pit with a series of 6 to 12 or more (variable with age), small and short furrows, which extend inward only a short distance from the edge. Arms rather short, not very unequal; the dorsal ones are a little the shortest and smallest; the third pair are the longest, the second and fourth pairs are intermediate in length, and nearly equal; the arms of the second pair are furnished with a well-developed membrane along the lower outer angle, and with a thin marginal membrane of moderate width along the inner angles, outside the suckers, that on the lower side extending beyond the suckers. Those of the third pair are compressed, with a well-developed membranous keel on the median outer edge, beyond the basal portion; on the lower inner angle there is a broad, thin, marginal membrane, extending beyond the suckers, and a narrow one on the upper side; the dorsal and ventral arms have narrow marginal membranes. Suckers of the dorsal and lateral arms furnished with horny rings which have the edge divided into small, acute-triangular teeth, largest on the outer side; on the ventral arms the suckers are smaller, those on the proximal half of the arm having smooth-edged rings, while those on the distal portion are sharply toothed on the outer edge. Tentacular arms slender and moderately elongated, with distinctly broader clubs, which are keeled on the back side and furnished with a thin marginal membrane on each edge. The suckers consist of two median alternating rows of larger oblique, dentate suckers, of which seven to nine in each row are decidedly largest;

alternating with these, on each margin there is a row of smaller, more oblique, sharply denticulate, marginal suckers; distal narrowed face of the club covered with four rows of minute crowded suckers, and a small cluster at the tip; the proximal part of the club has an irregular group of few, small, denticulate suckers, beyond which, extending down on the upper margin of the arm, is a row of about five or six small, smooth-edged, connective suckers, alternating with small round tubercles, of corresponding size; along the lower edge of the arm, for about the same distance, there is a row of more minute pedicelled suckers. The horny rings of the larger median suckers are oblique, and the edge is divided into many small slender teeth, longer on the outer margin; the teeth of the marginal suckers are similar, but more unequal and more incurved.

Specimens in alcohol generally show a distinct, dark purplish brown dorsal stripe, where the chromatophores are very much crowded.

Total length to tips of lateral arms, 121^{mm}; tail to base of arms, 93; body, 82; length of caudal fin, to insertion, 29; its breadth, 58; diameter of body, 16; length of tentacular arms, 48^{mm}. Young.

Middle Atlantic and West Indies; common in the region of the Gulf Stream.

This is an exceedingly active species, swimming with great velocity, and not rarely leaping so high out of the water as to fall on the decks of vessels. On this account it has been called the "*flying squid*," by sailors.

It is a more slender species than *O. illecebrosa*, with a shorter fin, and it has but four rows of small suckers on the distal part of the club, instead of eight. The most important differences, of generic value, are the presence of connective suckers and tubercles on the tentacular arms, and the great development of the marginal membranes on the lateral arms. The grooves in the siphon-pit are of comparatively little importance.

Gonatus Gray.

Gonatus Gray, Catalogue Mollusca Brit. Mus., i, Cephal. Antep., p. 67, 1849, (characters inaccurate.)

Body slender, tapering; caudal fins short, broad, united posteriorly. Pen narrow anteriorly; thin and lanceolate posteriorly, with a terminal, hood-like expansion. Sessile arms with four rows of small, pedicellated suckers, those of the two median rows larger, with a horny ring, having a single large hooked claw on the outer edge; outer

suckers with larger pedicels, the horny ring with several small denticles. All the suckers have a circle of minute scales or plates around the aperture. Tentacles long and slender, the terminal part dilated into a narrow club, with a membranous keel; the club is covered with minute denticulated suckers, like the outer ones of the sessile arms; smaller suckers extend for some distance along the arm; center of the club, with one or two larger suckers, resembling the median ones of the sessile arms, their horny rings having a small aperture, and bearing, on the outside, a large claw-like hook.

Gray overlooked the free eyelids in this genus, and on that account placed it with *Loligo*.

Gonatus Fabricii Verrill.

Sepia loligo Fabricius, Fauna Grœnlandica, p. 358, 1780, (good description).
Onychoteuthis Fabricii Lichtenstein, Isis, xix, 1818, (t. Gray).
Möller, Kroyer's Tidss., iv, p. 76, 1842.
Loligo Fabricii Blainville, Dict. Sci. Nat., xxvii, p. 138, 1823.
Onychoteuthis? amœna Möller, Ind. Moll. Grönl., Kröyer's Tidss., iv, p. 76, 1842, (young.)
Gonatus amœna Gray, Catal. Moll. Brit. Mus., i. Cephal. Antep., p. 68, 1849.
Gonatus amœnus G. O. Sars, Moll. Reg. Arct. Norvegiæ, p. 336, pl. 31, figs. 1–15 (excellent); pl. xvii, fig. 2 (dentition), 1878.
Tryon, Man. Conch., i, p. 168, pl. 73, fig. 290, (descr. from Gray, fig. from H. & A. Adams, Genera).
Verrill, Proc. Nat. Mus., iii, p. 362, 1880.

PLATE XLV, FIGURES 1–1*b*, 2–2*d*.

Body small, elongated, rather slender, tapering backward; front dorsal edge of mantle extending forward in a blunt lobe or angle. Caudal fin very short, but broad, nearly twice as broad as long, the front edges extending forward beyond the insertion, as rounded lobes, lateral angles subacute, posterior angle obtuse. Arms stout and rather long, the dorsal and ventral pairs stouter than the lateral. All the arms bear four rows of small suckers; those of the two median rows (2*c*, 2*d*) are larger than the outer ones, with shorter pedicels, and the very oblique horny ring, having a small opening, is developed into a single, large, hooked tooth on the outer side; around the inner side of the aperture there is a partial circle of small flat scales, in several rows. The suckers of the outer rows (2*a*, 2*b*) are about two-thirds as large, with longer and more slender pedicels, and with lateral apertures; the horny ring has about five acute-triangular teeth on the outer margin, and there are several rows of small scales forming a broad circle entirely around the aperture. The tentacular

arms are long and slender, with broader clubs, which bear a large number of minute suckers, much like the outer ones of the arms, arranged in many crowded rows, some of which extend beyond the club along the arm; in the middle (fig. 1*b*) there is usually one or two larger suckers (absent in our specimen) in which the horny ring has a small aperture and is developed into a large hook-shaped claw, on one side, and a complete circle of small plates surrounds the horny ring.

Pen, thin and delicate, narrow anteriorly, with slender lateral ribs; posteriorly, for more than half the whole length, expanded into a thin lanceolate form; posterior tip laterally dilated, with the edges involute (fig. 1).

A young specimen of this species, in nearly perfect preservation, was recently presented to the United States Fish Commission by Capt. William Demsey and crew, of the schooner "Clara F. Friend". It was taken from the stomach of a cod, off Seal Island, Nova Scotia.

Greenland (Fabricius, Möller). Porsangerfjord, northern coast of Norway (G. O. Sars). Coast of Finmark, in stomach of "coal-fish," abundant (G. O. Sars, Norwegian Exp. of 1878).

D'Orbigny, Gray, and other writers have erroneously referred the *Onychoteuthis Fabricii* (based on the *Sepia loligo* of Fabricius) to *O. Banksii*. The detailed Latin description given by Fabricius applies perfectly to the present species, and not at all to *O. Banksii*. He describes the four rows of suckers on the short arms; the small suckers and two large central hooks on the tentacles; the short caudal fin, etc.

Chiloteuthis, gen. nov.

Allied to *Enoploteuthis*, *Lestoteuthis* and *Abralia*, but with a more complicated armature than either of these genera. Sessile arms with sharp incurved claws, arranged in four rows on the ventral arms, and in two rows on the other arms, (distal portions have lost their armature). Tentacular arms long, with broad clubs, strongly keeled externally, and with series of convective suckers and tubercles extending for some distance along the inner surface of the arms. Tentacular club provided with a marginal row of connective suckers, alternating with tubercles, along one margin; with a central row of unequal hooks, some of them very large; with submedian groups of small, slender-pedicelled suckers (or hooks); with marginal series of small suckers; and with several rows of small suckers covering the prolonged distal portion of the face. Connective cartilages on the base of the siphon, simple, long-ovate; the corresponding processes of the mantle are simple longitudinal ridges. The caudal fin, pen, and many other parts are destroyed.

Chiloteuthis rapax, sp. nov.

PLATE XLIX, FIGURES 1–1 *f*.

A specimen of this remarkable squid, in very bad condition, was taken from the stomach of a fish, trawled at station 893, in 372 fathoms, about 100 miles south of Newport, R. I. It was accompanied by a specimen of *Ommastrephes illecebrosa*, in a similar condition. It had lost its pen, its epidermis, and most of the horny hooks and sucker-rings; the head was detached from the body and the caudal fin was nearly destroyed; the eye-lids were gone, but the eye-balls remained. The description must, therefore, remain imperfect till other specimens can be obtained.

The body was rather short and thick, tapering rapidly backward. The caudal fin appears to have been short-rhomboidal, but this is uncertain. The siphon is large, with an internal valve. The connective cartilages (fig. 1*e*) on the sides of the base of the siphon are long-ovate, with the posterior end widest and rounded. The corresponding cartilages on the inside of the mantle are simple longitudinal ridges. Head large, with very large eyes; pupils round. The arms are long and taper to slender tips; the dorsal ones are smaller and shorter than the others; the lateral and ventral pairs are nearly equal in length, and about as long as the mantle; the ventral arms are somewhat more slender than the lateral ones. All the arms appear to have borne slender-pedicelled claws or hooks with strongly incurved, horny points, but only the fleshy parts of these are left, in most cases, and the tips of the arms are bare. On the ventral arms these hooks were smaller, and in four rows; the fleshy portion of these consists of a small rounded head, with lateral lobes, running up, on one side, into an incurved beak, so that the shape is somewhat like a bird's head. On the other arms the claws were in two rows only, but they were much larger; in a few cases, on the lateral arms, the horny claws are left. These are strongly compressed and deeply imbedded in the muscular sheath, only the sharp, incurved point projecting (figs. 1*c*, 1*d*).

The tentacular-arms (fig. 1) are long and strong, their length being more than twice that of the sessile arms. The club is rather stout, long, decidedly expanded, and has an elevated, crest-like keel on the distal half of its dorsal surface; this keel rises abruptly at its origin, and is colored on the outer side, but white on the face next to the inner surface of the club. The club is broadest near its base, the distal third is narrow and the tip rounded. The armature is remarkable: in the middle line there is a row of six medium sized hooks (fig. 1, a''), followed by two much larger ones (fig. 1, a' a), situated near the mid-

dle; these have lost their horny claws; series of minute, slender-pedicelled suckers run along the club, either side of the median line, and beyond the large hooks these rows unite and entirely cover the face of the distal third of the club (fig. 1, *d*), there forming about eight rows; at the tip there is a circular group of minute suckers (*d'*); toward the base of the club the lower side is expanded and bears a row of five peculiar suckers (fig. 1, *e*), having a marginal series of slender, minute, incurved spinules; these suckers have very thick basal processes, which are appressed and directed toward the central line of the club, bearing the suckers on their inner ends, attached by short pedicels; round connective tubercles alternate with these suckers, in the same row; beyond these there is a triangular marginal group of slender-pedicelled suckers (*c*), of about the same size; other rows of minute pedicelled suckers (or hooks) occupied the sub-median area, between the marginal ones and the central line, which is indicated by a strong white cord. The opposite margin of the club appears to have borne several rows of small suckers, but this part is badly injured. A band of minute papillæ (*e'*), apparently the remnants of suckers and alternating connective tubercles, extends downward for more than half the length of the tentacular-arm; at first this band is like a continuation of the connective suckers and tubercles on the margin of the club, and the papillæ are apparently in a single row, while the surface near them is crossed by fine transverse grooves or furrows; but farther down the arms there may have been two or more rows of suckers, which have been destroyed.

The beak (fig. 1 *f*) is somewhat compressed, with very acute mandibles. The upper mandible has the point long and regularly incurved, with the cutting edge regularly arched, without a basal notch, and forming, with the anterior edge, an obtuse angle. Lower mandible, with a strongly incurved tip and regularly concave cutting edge, having no basal notch, and only a slight tooth on the anterior border, which forms a very obtuse angle with the cutting edge.

Color mostly gone, but where still remaining, as on the back of the tentacular club, it consists of minute purple chromatophores; inner surface of sessile arms purplish brown.

Measurements in millimeters.

Length of body	78	Breadth of club	7
Length of dorsal arms	58	Breadth of tentacular arms	5
Length of 2d pair of arms	86	Breadth of lateral arms, at base	6
Length of 3d pair of arms	87	Breadth of dorsal arms	5
Length of ventral arms	85	Diameter of eye-ball	19
Length of tentacular arms	225	Length of connec. cartilages on siphon	14
Length of club	29	Breadth of the same	4

Calliteuthis Verrill.

Amer. Journ. Sci., xx, p. 393, for Nov., 1880 (published Oct. 25); Proc. Nat. Mus., iii, p. 362, 1880.

Body short, tapering to a small free tip; fins small, united behind the tip of the body. Siphon united to the head by a pair of dorsal bands; not sunken in a furrow; an internal valve. Mantle united to the sides of the siphon by simple, linear, longitudinal lateral ridges, corresponding with connective cartilages on the sides of the siphon, which are long-ovate, with a raised margin all around. A dorsal elongated connective cartilage on the neck, opposite the pen. Arms long, not webbed; suckers in two rows, largest on the middle of the lateral and dorsal arms; horny rings of suckers smooth on most of the suckers, simply dentate on the distal ones. Eyes large, with rounded openings and thin, free lids. Buccal membrane simple, sack-like, with seven connective bridles. Internal anatomy of the female similar to that of *Ommastrephes*. Oviducts and nidamental glands symmetrically developed on the two sides. Oviducts opening in front of the bases of the gills, the openings simple, long, narrow, oblique. Two long, ligulate nidamental glands, with acute anterior ends, lie, side by side, and a little apart, on the middle of the visceral mass, behind and over the heart; each of these consists of two halves, folded together, and covered on the inner surface with fine transverse laminæ; the space between them opens along the outer edge.

Calliteuthis reversa Verrill.

Amer. Journ. Sci., xx. p. 393, Nov., 1880; Proc. Nat. Mus., iii, p. 362, Dec., 1880.

Plate XLVI, figures 1–1*b*.

Body rather short, tapering backward, subacute posteriorly; front edge of mantle advancing somewhat in the middle, and forming an obtuse angle; considerably emarginate beneath. Caudal fin small, short, thin, each half nearly semicircular, attached subdorsally, posterior end emarginate and free from the tip of the body, but not extending much beyond it. Head large, flattened above. Eyes very large, with simple, thin, free, circular lids, without any sinus. Openings of the ears, behind the eyes, minute, with a small, erect, clavate, fleshy process of the skin. Arms long, tapering, equal to the length of head and body combined; the lateral pairs are equal; the dorsal and ventral nearly equal, somewhat shorter than laterals; suckers deeper than broad, well rounded, laterally attached by slender pedicels; horny rings with smooth, circular, thin edges, except on the

small suckers, toward the tips of the arms, in which the outer edge is divided into a number of small, narrow, blunt teeth. On the ventral arms, the suckers are much smaller. Basal web rudimentary; a narrow, thin, simple membrane along each side, outside the suckers. Tentacular arms rather slender, compressed, smooth at base, the ends absent. Color reddish brown. The ventral surface of the body, head, and arms is more ornamented than the dorsal surface, being covered with large, rounded verrucæ, their center or anterior half pale, the border, or posterior half, dark purplish brown; upper surface of body with much fewer and smaller scattered verrucæ; a circle of the same around the eyes; inner surfaces of sessile arms and buccal membranes chocolate-brown, tentacular arms lighter; suckers pale yellow with a light brown band. Caudal fin white, translucent. Iris, in the preserved specimen, brown. Gills with the free edge brown, and a brown line on the outer edges of all the laminæ.

Total length, to end of lateral arms, 133^{mm}, to base of arms, 67^{mm}; mantle, 51^{mm}; of fin, 17^{mm}; breadth of fins, 24^{mm}; of body, 20^{mm}; diameter of eye-ball, 16^{mm}; length of dorsal arms, 58^{mm}; of second pair, 67^{mm}; of third pair, 68^{mm}; of ventral pair, 60^{mm}; breadth of dorsal arms at base, 5^{mm}; of lateral, 6^{mm}; diameter of largest suckers, $1{\cdot}2^{mm}$.

Dredged by the steamer "Fish Hawk," of the U. S. Fish Commission, at Station 894, about 100 miles south of Newport, R. I., N. Lat. 39° 53′; W. Long. 70° 58′ 30″, in 365 fathoms.

Mastigoteuthis Verrill.

Bulletin Mus. Comp. Zool., vi, 1881.

Body elongated, tapering to a point, confluent with the caudal fin posteriorly. Caudal fin very large and broad, rhomboidal, occupying about half the length of the body. Mantle fastened to the base of the siphon by an ovate, ear-shaped, elevated cartilage, on each side, fitting into corresponding deep, circumscribed pits on the base of the siphon. Siphon with a bilabiate aperture, an internal valve, and a pair of dorsal bridles. Eyes large, with round pupils; lids free, thin, apparently with a very small anterior sinus. Arms very unequal, the ventral ones much the longest. Suckers small, in two regular rows. Tentacular arms long and round, tapering to the tips, shaped like a whip-lash, without any distinct club; the distal portion is covered nearly all around with exceedingly numerous and minute suckers, which leave only a very narrow naked line along the outside. Pen narrow and bicostate anteriorly, very slender in the mid-

dle; posteriorly much larger, with a long tubular cone. This remarkable genus differs widely from all others hitherto described in the character of the tentacular arms and suckers. This, with the great size of the caudal fin, gives a very peculiar aspect to the species.

Mastigoteuthis Agassizii Verrill.

Bulletin Mus. Comp. Zool., vol. vi, pl. 1, fig. 1; pl. 2, figs. 2, 3-3*g*, 1881.

Plate XLVIII. Plate XLIX, figures 2, 3–3*g*.

Body elongated, round anteriorly; posteriorly tapering rapidly to the slender, acute, terminal portion, which is confluent with the caudal fin, to the tip. Front dorsal edge of mantle emarginate in the middle. Caudal fin very large and broad, transversely rhomboidal, obtuse posteriorly, its length, from origin to tip, about equal to half the combined length of the head and body. Eyes large, with thin lids, which appear to have had a distinct but very small sinus in front; pupils circular; iris brown, in alcohol. Sessile arms very unequal; ventral arms much larger and longer than the others, about equal to length of head and body; dorsal arms very small, scarcely one-third the length of the ventral pair; two lateral pairs nearly equal, decidedly longer and stouter than the dorsal pair. A delicate thin, marginal membrane extends along the arms, outside the rows of suckers, to the slender tips. Suckers small, in two regular rows on all the arms, subglobular, with small oblique apertures, surrounded by small horny rings, which have a nearly entire margin, and by several series of minute plates (Plate XLIX, fig. 3*g*).

Basal web, between the arms, very small. In the smaller specimen, which is a male, the right ventral arm is longer than the left, and the tip appears to have been flattened, and the marginal membranes seem to have been wider, with the edges infolded, so as to form a sort of furrow on the outer side, but the suckers are mostly gone, and it is too much injured to be accurately described. Tentacular arms long, more than twice the combined length of the head and body, slender, round, gradually tapering to the tip, like a whiplash, the distal half of their length covered with very numerous, crowded, minute, pedicelled suckers (fig. 3*d*), which cover nearly the entire surface along the terminal portion, leaving only a narrow naked line along the back, but farther from the tip this naked space becomes gradually wider and the band of suckers narrower, and after these crowded bands of suckers cease, scattered suckers, placed mostly two by two, extend for some distance along the proximal part of the arms. The suckers of the tentacular arms are so small that their form can-

not be seen with the naked eye; they are deep, cup-shaped, with a small circular aperture, supported by a horny rim, which is often armed with two or three sharp teeth on one side (fig. 3*e*).

Color of body and arms, so far as preserved, in alcohol, deep brownish orange; on the upper side of the back and caudal fin the color is better preserved, and shows small, ocellated, circular spots of orange-brown, with an inner circle of whitish, and a central spot of purplish brown. Similar spots also exist on the head and arms, and also on the lower side of the body, where the color is best preserved.

A considerable amount of a bright orange oily fluid, insoluble in alcohol, exuded from the viscera. Examined by means of the spectroscope this fluid absorbed part of the green, all of the blue, and most of the violet rays. The stomach contained fragments of small crustacea. The pen is pale yellow, thin, and slender anteriorly, with two sublateral costæ, and narrow delicate margins outside the costæ; in the middle it becomes still thinner and narrower, with the margin inrolled; beyond, the margins become much wider and then unite together ventrally, forming a long, hollow, conical portion, extending to the acute posterior tip; this portion is not so broad as deep, and has a slight dorsal keel and ventral groove.

Measurements in millimeters.

	Male.	Male.
Total length to end of sessile arms	137	232
Head and body combined	59	122
Length of body	46	99
Length of caudal fin, from origin	30	60
Breadth of caudal fin	42	75
Breadth of body	15	23
Length of dorsal arms	24	45
Length of 2d pair of arms	33	60
Length of 3d pair of arms	34	60
Length of ventral arms	80	112
Length of tentacular arms	--	312
Breadth of dorsal arms, at base	3	4
Breadth of ventral arms	6	7
Breadth of tentacular arms	2	4
Diameter of eye	7·5	9
Length of pen	--	198
Breadth of pen anteriorly	--	2·25
Breadth of pen posteriorly	--	2·50
Depth of pen posteriorly	--	4·50

Specimens examined.

No.	Locality.	Fath.	When Rec'd.	Name of Vessel.	Rec'd from	Spec. No.	Sex.
24	cccxxv. N.L. 33°25′20″ W.Lg. 76°	647	1880	Blake	Mus. Comp. Zool.	1	♂
25	cccxxviii. N.L. 34°28′25″ W.Lg. 75°22′50″	1632	1880	Blake	Mus. Comp. Zool.	1	♂

Chiroteuthis Bonplandi D'Orb. (?).

Loligopsis Bonplandi Verany, Acad. Turin, ser. II, vol. i, Pl. 5. (Specimen without tentacular arms, t. D'Orb.).

Chiroteuthis Bonplandi D'Orbigny, Céphal. Acétab., p. 226. (Description compiled from Verany).

Verrill, Bulletin Mus. Comp. Zoöl., vol. viii, Pl. 3, figs. 1–1*b*, 1881.

PLATE XLVII, FIGURES 1–1*b*.

A detached tentacular arm, belonging to a species of *Chiroteuthis*, was taken by the U. S. Coast Survey steamer "Blake," in the summer of 1880, at station CCCIII, lat. 41° 34′ 30″, long. 65° 54′ 30″, in 306 fathoms.

The arm is very long and slender; the length being 780^{mm} (or over 30 inches); its diameter being from 1·5 to 2^{mm}, except near the base, where it is 3^{mm}, and at the terminal club, which is 6^{mm} broad, and 54^{mm} long. The arm is white, with purplish specks, and is generally roundish, except at the club; along the greater part of its length there is a row of rather distant sessile suckers, the distance between them being usually from 12–18^{mm}; these suckers are larger than those of the club and have a nearly flat upper surface and no horny marginal rim. A row of small, simple, scattered pits, perhaps homologues of these suckers, extends up the back side of the club. These smooth suckers evidently serve to unite the tentacular arms together, when used in concert. The club is stouter than the rest of the arm, convex on both sides, and but little flattened; on each side it is bordered by a well developed, marginal membrane, supported by a series of transverse, thickened, but flat, tapering, acute, muscular processes, with their ends projecting beyond the edge of the membrane, as digitations; on the distal half of the club, these are separated by spaces greater than their breadth, but on the proximal portion they subdivide into two or three parts, which become crowded close together, showing only narrow intervals or merely a groove between them. At the tip of the arm there is a thick, ovate, dark purple, spoon-shaped, hollow organ, about 4^{mm} long, with its opening on the back side of the arm. This so strongly resembles the spoon-shaped organ of the hectocotylized arm of some Octopods, as to suggest the possibility of a similar use, for sexual purposes. The suckers are crowded in 4 to 8 indistinct rows. Their pedicels are long and slender, having beyond the middle a large, dark purple, fluted, swollen portion, beyond which the pedicel is more slender; the cup of the sucker is small and deep, with a very oblique, oblong-ovate, lateral opening; horny rim, not distinctly toothed (fig. 1*b*).

Histioteuthis Collinsii Verrill.

Amer. Journ. Sci., xvii, p. 241, March, 1879; xix, p. 290, 1880.
Tryon, Man. Conch., i, p. 166, 1879, (copied from preceding.)
Verrill, this vol., p. 234, Plate 22, Feb., 1879.

Plate XXII. Plate XXVII, figures 3–5. Plate XXXVII, figure 5.

In addition to the original specimen, figured and described in Part I of this article (see p. 234), another specimen, represented by the jaws alone, has been received by the U. S. Fish Commission, from the Gloucester fisheries. (Lot 843.)

This was obtained on the Western Bank, off Nova Scotia.

Another beak was dredged by the "Fish Hawk," at station 893, south of Newport, R. I., in 372 fathoms.

These jaws agree well in size and all other characters, with those of the original specimen (Pl. XXVII, fig. 4).

Family.—Desmoteuthidæ nov.

For the reception of the genera, *Desmoteuthis* V. and *Taonius* St., as defined below, I propose to establish this new family, which has hitherto been confounded with *Cranchidæ* and *Loligopsidæ*.

Body much elongated, pointed posteriorly; caudal fin narrow, terminal, mantle united to neck by a dorsal and two lateral muscular commissures. Pen lance-shaped, as long as the mantle, with a long narrow shaft; blade incurved or hooded posteriorly. Œsophagus and intestine very much elongated. Nidamental glands large, symmetrical. Eyes large, protuberant; lids free and simple. No auditory crests. Siphon large, with neither internal valve nor dorsal bridle. Arms with depressed suckers. Tentacular arms with a well-developed club, bearing suckers.

Desmoteuthis, gen. nov.

Taonius (*pars*) Steenstrup, 1861.

Body very long, tapering backward to a long, slender, acute caudal portion. Caudal fin long, narrow, tapering to a long acute tip. Anterior edge of the mantle united directly to the head, on the dorsal side, by a commissure, so that there is no free edge, medially, and the surface is continuous, as in *Sepiola*; the dorsal commissure extends backward and diverges within the mantle; two additional muscular commissures unite the lateral inner surfaces of the mantle to the sides of the siphon. Eyes very large and prominent, with simple circular lids. No aquiferous pores. Siphon large and prominent, with neither valve nor dorsal bridles. Arms small and short,

subequal, with a basal web and lateral membranes; suckers smallest on the ventral arms, and urceolate; largest and flatish on the middle of the lateral and dorsal arms; feebly toothed. Pen extending the whole length of the body, very slender and of uniform width for more than half the length, then becoming broad-lanceolate, the terminal portion having the edges involute, forming a long slender cone, into which the ovary extends. Nidamental glands large, symmetrically developed on the two sides. Gills small, situated in front of the middle of the body.

The genus *Taonius* was proposed by Steenstrup to include this and *T. pavo* (Les. sp.), but he has never, to my knowledge, definitely defined the genus. As *T. pavo* appears to be generically distinct from the present genus, I propose to retain *Taonius*, with *T. pavo* for its type. By many writers *T. pavo* has been placed in *Loligopsis*, or *Leachia*. Steenstrup himself, formerly referred *D. hyperborea* to *Leachia*. By Tryon, both have been referred back to *Loligopsis*.

Loligopsis, as defined by D'Orbigny, in 1839, included *T. pavo*, as well as the type of *Leachia*, but he referred Lamarck's original type of *Loligopsis* to the genus, as emended by him, only with doubt.

It seems desirable, therefore, to explain this confusion, so far as possible.

Loligopsis Lamarck,* 1812 and 1822, was based only on an imperfect figure, made by Péron, of a small oceanic squid, which had lost its tentacular arms. The supposed character of having *eight arms* was, for him, the only basis for the genus, no others being mentioned. The species (*L. Peronii*) was, however, described very briefly as a small squid with eight equal arms and two posterior, distinct caudal fins, and it was compared to *Sepiola*. It has apparently not been rediscovered by later writers, unless *L. chrysophthalma* D'Orb., be the same species, which is quite possible. The latter, as figured, is a small, *short-bodied species, with distinct, separate, small, caudal fins, which are free from the end of the body;* its mantle-edge is also represented as free, dorsally. This evidently is a generic type distinct from *Taonius* and *Desmoteuthis*. Indeed, it probably will be found not to belong to the same *family*, when actually studied. Therefore it seems necessary to allow the name *Loligopsis* to remain connected with such small, short-bodied species, for which, alone, it was originally used. The genus, in its original sense, cannot yet be regarded as fully established.

* Extr. de Cours de Zoöl., p. 123, 1812 (t. D'Orb.); Animaux sans vert., vii, p. 659, 1822.

Leachia Lesueur, 1821* (= *Perothis* (Esch.) Rathke, 1835), was also based on an *imperfect figure* of a small Pacific Ocean squid, which had likewise lost its tentacular arms. The only generic character given was, as in Lamarck's case, the presence of only eight arms,—a purely fictitious character. The type of this genus was *Leachia cyclura* Les. It has a more elongated body, slender posteriorly, with a more or less rounded caudal fin, the two sides of the fin completely united together and to the posterior end of the body. The third pair of arms is much larger than the others. The anterior dorsal edge of the mantle is represented as *free*, in all the figures, but, according to D'Orbigny, there is an internal, dorsal commissure, and also two lateral ones. The visceral anatomy of one species of this group (*L. guttata* Grant), which D'Orbigny refers, probably correctly,† to the original *L. cyclura*, is pretty well known, and is widely different from that of *Desmoteuthis* (see Pl. XXXIX, fig. 1), as well as from that of *Taonius*, so far as the latter is known.

There can be no doubt whatever as to the generic distinctness of *Leachia*, if the *anatomy* be taken into account. (See the figures of Grant and D'Orbigny.)

Taonius Steenstrup, 1861, (type *T. pavo*). This differs from the two preceding genera in its more elongated form, narrow caudal fin, etc. From *Leachia* and *Desmoteuthis* it differs in the form of its pen. The dorsal edge of the mantle is represented and described as free by D'Orbigny. The anatomical characters are not known.

Desmoteuthis hyperborea Verrill.

Leachia hyperborea Steenstrup, Kongelige Danske Vidensk. Selsk. Skrifter, 5 r., iv, p. 200, 1856 (sep. copies, p. 16).

Taonius hyperboreus Steenst., Oversigt Kgl. Danske Vidensk. Selsk., Forhandlinger, 1861, p. 83.

Verrill, Amer. Journ. Sci., xvii, p. 243, 1879; xix, p. 290, 1880.

Loligopsis hyperboreus Tryon, op. cit., p. 162 (inaccurate translation, after Steenstrup).

PLATE XXVII, FIGURES 1, 2. PLATE XXXIX, FIGURE 1 (anatomy).

♀. Body very long, tapering gradually backward, and ending in a long, slender, acute tail; mantle soft and flabby, with a capacious branchial cavity; anterior dorsal edge advancing somewhat in the

* Journal Philad. Acad., ii, p. 89, pl. 2.

† Tryon criticizes this determination, because Lesueur "describes and figures a smooth species," while *L. guttata* has two rows of curious tubercles *on the ventral side*. But as Lesueur only *described a figure of the dorsal surface*, his objection to this identification is absurd.

middle and directly united to the head, so as to leave no free edge medially, by a rather wide commissural band, the sides of which diverge as they extend backward within the mantle. Caudal fin long, narrow, lanceolate, narrowly acuminate to a very long, acute tip; the anterior insertions are wide apart, and the anterior border is rounded. Head short and small, exclusive of the eyes, which are very large, globular, and prominent, their lower sides in contact beneath the head; openings round, looking somewhat downward; pupils large and round; lids thin and simple. Siphon very large and prominent, extending forward between the eyes, but without a special groove; dorsal surface firmly united to the head by a thick commissure, leaving about half the length free; opening large, without any valve.

Arms comparatively small and short, none of them complete, in our specimen, except those of the 3d and 4th pairs, which are nearly equal in length, the ventral ones a little the shortest and most slender; the dorsal and 2d pairs of arms have lost their distal portions, but the parts of the dorsal arms remaining correspond in size with the ventral ones; and those of the 2d pair with the 3d pair. The arms are all united together by a thin, delicate basal web, which extends up some distance between the arms (farthest between the dorsal pair), and then runs along the sides of the arms, as broad, thin, marginal membranes, to the tips. Suckers of the ventral arms smaller and different in form from those of the others, all of them being urceolate, with narrow apertures, surrounded by a slightly enlarged border, and having small horny rings with the edge entire, or nearly so, on the proximal suckers, but on the smaller ones, toward the tip, with a few broad blunt teeth on the outer edge. On the dorsal and lateral arms the basal suckers are ventricose and urceolate, like those of the ventral arms, but along the middle portion of these arms the suckers become much larger, and have a broad shallow form, with wide apertures and expanded bases; the horny rings of these larger suckers are divided into several broad, bluntly rounded teeth on the outer edge; toward the tips of the arms the smaller suckers again become deeper, with more contracted apertures, and with a few more prominent denticles on the rings.

Outer buccal membrane with seven obtuse angles, and united to the arms by eight bridles, or commissures, of which the upper one is double. Exposed part of the beak black; mandibles very acute, strongly incurved.

Pen very thin and narrow, and of nearly uniform width (4^{mm}) for more than half its length; at about four-sevenths of its length, from

the anterior end, it gradually expands laterally into a broad, very thin, lanceolate form, becoming, opposite the broadest part of the fin, 30^{mm} wide, with very delicate lateral expansions and with a pretty strong dorsal keel; farther back it tapers and is very acuminate, the lateral margins becoming involute, so as to form a very long, slender, acute, terminal, hollow cone, extending to the tip of the tail. The anterior end is obtusely rounded and thin; a short distance from the anterior end there are two thin lateral processes, directed forward, to which the commissural muscles were attached.

Color of entire body, siphon, and caudal fin, dark brown, thickly covered with large roundish unequal spots of darker brown, and paler brown, intermixed; head, eyes, arms, and web, dark brownish purple, with crowded chromatophores; suckers yellowish.

Total length, to end of lateral arms, 16 inches; to dorsal edge of mantle, 13; length of head, 1; diameter of eye, 1; length of caudal fin, 5; its breadth, 1·80 inches.*

Measurements in millimeters.

	A. ♀	B.
Length to tip of lateral arms,	410	---
Length to base of arms,	354	---
Length to edge of mantle, above,	330	210
Length of caudal fin,	127	103
Breadth of caudal fin,	46	18
Diameter of body,	57	---
Diameter of eye,	25	26
Length of 3d pair of arms,	56	63
Length of ventral arms,	52	38
Diameter of largest suckers of lateral arms,	3	5
Length of pen,	330	--
Of anterior linear portion,	180	--
Of posterior lanceolate part,	150	--
Breadth of anterior portion,	3	--
Breadth of lanceolate part,	30	--

A. is the specimen described above; B. is the specimen described by Steenstrup from Greenland. The latter had the dorsal arms 40^{mm} long; 2d pair 50^{mm}; tentacular arms 68 and 70^{mm} respectively. The larger size of the suckers of the latter may indicate that it was a male.

Our specimen was taken near the northern edge of the Gulf Stream, W. long. 55°, by Thomas Lee, of the schooner "Wm. H. Oaks," Jan., 1879, and by him presented to the U. S. Fish Commission. Baffin's Bay, Northern Greenland (Steenstrup).

* Some of these measurements are slightly larger than those originally given. This is due to the fact that the specimen has been kept, since first received, in somewhat weaker alcohol, and has become more relaxed in consequence of this, combined with repeated handling.

Notes on the Visceral Anatomy.

PLATE XXXIX, FIGURE 1.

The only specimen of this species obtained had the internal organs considerably injured, but the anatomy is so unlike that of the more common genera of squids, that it seemed to me desirable to figure such parts as are preserved.

This specimen is a female and the large nidamental glands (*x'*, *xx*, *xx'*) are symmetrically developed, on the two sides; these are swollen, voluminous organs, composed of great numbers of internal lamellæ; the anterior ones (*x'*) occupy the region around, and in front of the bases of the gills, extending forward and having an oblique, oblong opening (*op*, *op'*) on the outside of the anterior ends; the posterior ones (*xx*, *xx'*) are behind the gills and cover the branchial auricles, the oblique, slit-like opening is on the outside of the posterior ends; the gland on the left side (*xx'*) was mutilated; the posterior vena-cava, in front of *r'*, passes through the center of the posterior gland (*xx*). The ovary (*ov*) is a very long organ, attached to the stomach (*s*) and to the sides of its long cæcal appendage; it extends far backward to near the tip of the tail, occupying the concavity of the pen (*p*); it consists of great numbers of small clustered folicles; connected with its anterior end, and attached to the stomach, there is a convoluted tube, probably an oviduct, not shown in the figure; connected with the intestine, near its origin (between *s* and *l*), there is a firm, rounded organ (gizzard?), with internal lamellæ, opening into the intestine. The stomach was much mutilated, so that its form could not be certainly made out; its cavity is occupied by numerous longitudinal folds; a very long, saccular cæcal appendage, longitudinally plicated within, runs back, along the ovary, into the caudal cavity of the pen. The œsophagus had been destroyed. The intestine (*l*, *h*) is very long and slender, internally longitudinally plicated, and externally covered along nearly its whole length, on one side, by close groups of small, glandular folicles (*l*, *l*); the posterior portion is closely attached to the ventral edge of the smooth, compressed, oblong-ovate liver (*i*), and the free, stout, anal end (*h*) is provided with two slender, tapering cirri. Ink-sac small, pyriform.

The gills (*g*, *g*) are small and short, situated far forward, and connected to the ventricle of the heart (*H*), by long afferent vessels (*bo*); the branchial auricles (*au*, *au*) are rounded, without terminal capsules; the ventricle of the heart (*H*), as preserved, is small and four-lobed. The largest lobe directed forward and passing into the anterior aorta. The condition of the specimen did not permit the circulation to

be much studied. The two large, fusiform, cellular organs (r', r') are probably renal in nature; their interior is filled with large, irregular cavities or lacunæ, which appear to be connected with the posterior venæ cavæ (vc'').

Taonius Steenstrup.

Loligo (*pars*) Lesueur, Journ. Philad. Acad., ii, p. 96, 1821.
Loligopsis (*pars*) D'Orbigny, Céph. Acétab., p. 320, (*non* Lamarck).
Gray (*pars*), Catal. Moll. Brit. Mus., i, p. 39, 1849.
Taonius (*pars*) Steenstrup, Oversigt Kgl. Danske Vidensk. Selsk. Forh., 1861, pp. 70, 85.

This genus seems to bear about the same relation to *Desmoteuthis* that *Rossia* does to *Sepiola*. Its relations with *Loligopsis* and *Leachia* have already been discussed (pp. 301, 302). The body is short-pointed posteriorly. The caudal fin is long-cordate, but not slender pointed. The pen is lance-shaped, the anterior portion being long, narrow, of nearly uniform width; posterior end broad-lanceolate, short-pointed posteriorly, and, according to the figures, without a cone at the tip. The anterior dorsal edge of the mantle is represented as free externally, but there is a dorsal commissure within the mantle-cavity, and a lateral one on each side. Arms short, subequal; suckers flat, denticulate; those of the tentacles with sharp, incurved teeth. Eyes large, globular, prominent, lids free and simple.

Siphon with neither valve, nor dorsal bridle. No external ears, nuchal crests, nor cephalic aquiferous pores.

Taonius pavo Steenstrup.

Loligo pavo Lesueur, Journal Acad. Nat. Science Philad., ii, p. 96, with a Plate, 1821.
Loligopsis pavo Ferussac and D'Orb., Céph. Acétab., p. 321, Calmars, Pl. 6, figs. 1–4, (after Lesueur): Loligopsis, Pl. 4, figs. 1–8 (details, original).
Binney, in Gould, Invert. Mass., ed. II, p. 309, (but *not* the figure, Pl. 26).
Verrill, Amer. Journ. Sci., xix, p. 290, 1880.
Tryon, Amer. Mar. Conch., p. 9, Pl. 1, fig. 3 (after Lesueur); Man. Conch., i, p. 163, Pl. 68, fig. 252, Pl. 69, fig. 253, 1879 (descr. from Gray, figures from Lesueur and D'Orb.).
Taonius pavo Steenst., Oversigt Kgl. Danske Vidensk. Selsk. Forh., 1861, pp. 70 and 85.

This species differs externally from the preceding in having a much shorter, obtuse, oblong-cordate, fin, instead of a long, slender, pointed one, and by its very distinct coloration. According to Lesueur the general color is carmine-brown, the mantle, head, and arms "covered on every part with very large ocellations, which are connected together by smaller intermediate ones." Length of mantle, 10 inches.

Sandy Bay, Mass. (Lesueur). Newfoundland (Steenstrup). Off Madeira (D'Orbigny).

No instance of the occurrence of this oceanic species on the New England coast has been recorded since the original specimen was described by Lesueur, in 1821. The circumstances connected with the history of his specimen are such as to render it not improbable that some interchange of labels had occurred in his case. Therefore, the New England habitat, for this species, needs confirmation.

Lesueur's statement (loc. cit., p. 94) is that when at Sandy Bay, Mass. (on Cape Ann), in 1816, he saw a "great number" of squids ("*Loligos*") that had been taken by the fishermen for bait, and that: "The beautiful color with which they were ornamented, induced me to take a drawing of one immediately, but not then having leisure to complete it, I took a specimen with me to finish the drawing at my leisure. But recently [in 1821] upon comparing this specimen with my drawing, I was much surprised to perceive that I had brought with me a very distinct species from that which I had observed [*O. illecebrosus*]. I mention this circumstance to explain the cause of the brevity of the following description [of *O. illecebrosus*] taken from my drawing." The drawing was also inaccurate, for the same reason.

Loligo Lamarck, 1779.

Loligo (pars) Lamarck, Syst. Anim. sans vert., p. 60, 1801.
Pteroteuthis (sub-genus) Blainville, Man. Malac., p. 367, 1825.
Loligo (restricted) D'Orbigny, Céph. Acétab., p. 305, 1848.

Body more or less elongated, tapering to a point behind; anterior edge of mantle free dorsally, and prolonged into a lobe, covering the end of the pen. Caudal fin elongated-rhomboidal, united to the sides of the body to the tip. Mantle connected to the neck by a dorsal and two lateral connective cartilages; lateral cartilages of the mantle simple, longitudinal ridges; corresponding cartilages, on the base of the siphon, irregularly ovate, with a median groove. Pen as long as the mantle, anteriorly narrow, with a central keel, and two lateral ridges; posteriorly broad, thin, lanceolate, concave, but not involute. Head rather large; eyes without lids, covered with transparent skin, pupil encroached upon dorsally by the iris; a small pore in front of the eyes; behind the eyes, on each side, there is an oblique transverse, and two longitudinal, erect, thin crests, in relation with the ears. Siphon situated in a shallow groove, united to the head by two dorsal bridles, and furnished with an internal valve. Six buccal aquiferous pores, and a pair of branchial pores, one on

each side, between the bases of the 3d and 4th pairs of arms. Buccal membrane with seven elongated points, covered on their inner surfaces with small suckers; in the female with a special organ (Pl. XXIX, fig. 4, *s*), below the beak, on the ventral side, for the attachment of the spermatophores.

Sessile arms angular; basal web rudimentary or none; suckers in two rows, oblique, deep cup-shaped; horny rings toothed on the broad side, and surrounded with a median ridge. Male with one of the ventral arms (usually the left) hectocotylized, near the tip, by an enlargement of the bases of the pedicels of the suckers and a decrease, or disappearance, of the cups. Tentacular arms long and strong, with an expanded club, provided with marginal membranes and a dorsal keel; suckers, on the widest part, usually in four rows, those in the two central rows larger, broad urceolate; smaller ones cover the proximal and distal portions; no connective suckers on the club or along the arm.

Oviduct large, developed only on the left side. Nidamental glands large, in front of heart. Eggs in fusiform, gelatinous capsules, attached by one end, and usually radially united into large clusters.

Loligo Pealei Lesueur.

Typical form.

Loligo Pealei Lesueur, Journ. Acad. Nat. Sci. Philad., vol. ii, p. 92, Plate 8, 1821.

Loligo Pealii Blainville, Dict. Sci. Nat., xxvii, p. 144, 1823.

Férussac and D'Orbigny, Céph. Acétab., p. 311, Calmars, Pl. 11, figs. 1–5, Pl. 20, figs. 17–21 (details).

Gray (*Pealii*), Catal. Moll. Brit. Mus., i, p. 71, 1849.

Binney in Gould's Invert. Mass., ed. 2, p. 514, Pl. 25, figs. 339, 340, (figure erroneously referred to *O. Bartramii*).

Verrill (*Pealii*), Report on Invert. Vineyard Sd., pp. 440, 635 (sep. copies, p. 341), Pl. 20, figs. 102–105, 1877.

Tryon (*Pealii*), Man. Conch., i, p. 142, Pl. 51, figs. 133–140, (figs. from Fér. and D'Orb., and Dekay).

Verrill, Amer. Journ. Sci., iii, p. 281, 1872; Amer. Naturalist, viii, p. 170 (habits); Amer. Journ. Sci., xix, p. 292, 1880 (descr.).

Loligo punctata Dekay, Nat. Hist. N. Y., Mollusca, p. 3, Pl. 1, fig. 1, 1843 (young).

Binney, in Gould Invert. Mass., p. 513 (after Dekay).

Tryon, Amer. Mar. Conch., p. 14, Pl. 43, figs. 10, 11 (after Dekay).

Variety, borealis Verrill.

Loligo Pealei, var. borealis Verrill, Amer. Journ. Sci., xix, p. 292, 1880.

Variety, pallida Verrill.

Loligo pallida Verrill, Rep. Invert. Viney. Sd., in Rep. U. S. Com. Fish and Fisheries, i, p. 635, [341], Pl. 20, figs. 101, 101a, 1874.

Loligo Pealei Lesueur (continued).

Tryon, Man. Conch., p. 143, Pl. 52, figs. 141, 142, (descr., and figs. copied from preceding).

Verrill, Amer. Journ. Sci., xix, p. 292, 1880.

PLATE XXIX, FIGS. 1–4. PLATE XXXVII, FIGS. 1–3 (pens). PLATE XXXIX, FIG. 4 (odontophore). PLATE XL (anatomy). PLATE XLI (anatomy and young). PLATE XLV, FIGS. 3, 4 (young).

Body rather elongated, more or less stout, according to state of distention or contraction,* tapering backward to a moderately acute posterior end, more acute in the male than in the female. Caudal fin long-rhomboidal, with the outer angles very obtusely rounded; and varying, according to age, in the ratio of its length to its breadth, and greatly, also, in the proportion that its length bears to that of the mantle.† The length of the caudal fin, in proportion to that of the body (mantle), although variable, normally increases with age, even after sexual maturity. In this species, with specimens having the mantle from 100 to 125^{mm} long, the ratio of the fin to the mantle usually varies from 1 : 1·80 to 1 : 1·90; with the mantle 150 to 175^{mm} long, the ratio usually becomes 1 : 1·65 to 1 : 1·75; in the largest specimens, with the mantle, 260 to 400^{mm} long, the ratio varies from 1 : 1·50 to 1 : 1·65, rarely becoming 1 : 1·75. The ratio of the breadth of the caudal fin to the length of the mantle, in the larger male specimens, ranges from 1 : 2·12 to 1 : 2·40, varying considerably according to the mode of preservation; in the larger females it varies from 1 : 1·70 to 1 : 2·12.

The anterior ventral edge of the mantle recedes, in front of the siphon, in a broad curve, leaving an obtuse angle at either side, opposite the lateral cartilages; from these angles it again recedes, on the sides, in a concave line, and then projects considerably forward, forming a prominent, median, dorsal lobe, which gradually tapers from the base, and then rather suddenly narrows to a point, over the end of the pen; the point, when in its normal position, reaches as far

* The mantle, when the gill-cavity is distended with water, has a larger size than when the water is expelled by the contraction of its walls, which is usually the condition in which specimens die. Moreover, when the large stomach is distended with food, and when the ovary is distended, in the breeding season, with eggs, the form is stouter than usual.

† This variation is largely independent of sex, and is due partly to the ordinary changes during growth; partly to the condition of the muscular tissues at the time of death; and partly to the effects of the alcohol in which they have been preserved. These latter causes, in the case of preserved specimens, more or less obscure the effects of growth in causing the proportions to change.

forward as the posterior border of the eye, or even beyond it. Dorsal connective cartilage long, tapering backwards, with a very prominent, broad, dorsal keel; the anterior end is free and shaped like the end of the pen. Siphon large, rounded anteriorly, with a broad, bilabiate opening; lateral cartilages (Pl. XL, fig. 1, *f*) long and narrow, subacute anteriorly, posterior end with a thin, rounded, outer lobe; median groove narrow. The connective cartilages of the mantle (fig. 1, *f'*) are simple, longitudinal ridges, fading out gradually posteriorly. Head moderately large, usually narrower than the mantle; smaller in the male than in the female; eyes large; nuchal crests (fig. 1, *ob*) above the ear, formed by longer upper, and shorter inferior, oblique, longitudinal membranes, the two united by a doubly curved, or V-shaped membrane, having its angle directed forward, the whole having a rude, W-shaped form.

Arms large, stout, the three upper pairs successively longer; the ventral ones a little shorter than the third pair, and a little longer than the second pair. All the arms have narrow, thin, marginal membranes, strengthened by strong, transverse, muscular ridges. The first and second pairs of arms are trapezoidal at base; third pair stouter, compressed, with a keel on the middle of the outer side. Suckers in two regular rows on all the arms, deep, very oblique; largest on the lateral arms; those on the ventral arms are smaller, but otherwise similar. Horny rings yellowish, or brownish (white when fresh), strong; on the larger proximal suckers the outer or higher side is divided into about six broad, flattened, incurved teeth, which are blunt, subtruncate, and sometimes even emarginate at tip, remainder of margin nearly even; the smaller suckers, toward the tips of the arms, have the teeth longer, much more slender, and more acute.

The tentacular arm (Pl. XXIX, fig. 2) with fresh specimens, in full extension, may reach back nearly to the end of the body; with preserved specimens it seldom extends beyond the middle of the caudal fin; it is rather slender, compressed, and has a narrow, thin, membranous keel along the outer edge, which becomes wider at the club; on the distal half of the club it is much wider and runs a little obliquely along the back part of the upper side, where it is usually folded down against the side, its inner surface being whitish. The club is rather broad and thick, with a wide, scalloped, marginal membrane along each edge; these membranes are strengthened by transverse muscular ridges, which commence between the large central suckers and fork at the pedicels of the marginal ones. Along

the center of the club there are two alternating rows of large, broad, depressed suckers, about seven in each, with a few smaller ones, of the same series, at both ends; along each edge, alternating with the large suckers, there is a row of smaller and more oblique marginal suckers, about half as large. The proximal part of the club bears only a few small denticulated suckers; the distal part bears a large number of small, sharply denticulated, pedicelled suckers, crowdedly arranged in four rows; close to the tips of the arms about twenty of the small suckers have smooth rims and very short pedicels, but are still in four rows. The large suckers vary greatly in relative size, according to age, sex, season, and locality; they are a little higher on one side than on the other, with a broad aperture, surrounded by a horny, marginal ring, which is divided all around into sharp, unequal teeth, which are larger on the outer side (Pl. XL, fig. 5); usually one minute, sharp tooth stands between two larger ones, and these sets of three stand between still larger and less acute ones; the horny ring is surrounded by a wide, thick, soft, marginal membrane; below the border, a groove surrounds the sucker, and below this there is a basal swelling, equalling or exceeding the margin in diameter. The smaller marginal suckers (Pl. XL, fig. 4*a*, 4*b*) have the aperture more oblique and the horny ring much wider on the outer side, with its outer, sharp, marginal teeth longer and more incurved; usually these have the teeth alternately larger and smaller.

The outer buccal membrane (Plate XXIX, fig. 4) is large, thin, with seven prominent, elongated, acute angles, all of which have a cluster of about ten to fifteen, small, pedicelled suckers, in two rows, on the inner surface (*a*, *b*, *c*, *d*). These suckers have horny rings, denticulated on one side. In the female there is a special thickened organ (*s*) in the form of a horse-shoe, on the inner ventral surface of the buccal membrane. This in the breeding season serves for the attachment of the spermatophores by the male.

The muscular pharynx (fig. 4, *e*, *f*) containing the jaws can be protruded its whole length. The inner buccal membrane (*f*) or sheath enclosing the beak (*m*), has a prominent, thickened, radially-wrinkled and puckered anterior margin. On the ventral side the pharynx bears, externally, two thin chitinous plates, not connected with the jaws. The points and exposed edges of the beak are hard and black, becoming dark reddish brown farther back; the alæ, gular and palatine laminæ are thin and pale yellowish or light amber-color, in alcoholic specimens. The upper mandible (Pl. XXXIV, figs. 4, 4*a*, *var. pallida*) has a sharp, strongly-incurved point; cutting edge regularly

curved, with a triangular notch at its base, followed by a prominent triangular tooth on the alar edge, beyond which the edge is nearly straight, but recedes somewhat. Lower mandible with a sharply incurved point and sinuous cutting edges, which have a slight tooth below the middle and only a slight rounded notch at base, which passes gradually into the very oblique and receding alar edge. The bilobed palate is covered with a chitinous membrane which bears transparent, small, sharp, recurved denticles.

Odontophore with pale amber-colored teeth, and thin transparent borders. The median teeth (Pl. XXXIV, fig. 3; Pl. XXXVII, fig. 6, *a*; Pl. XXXIX, fig. 4) are broad with a long acute median denticle, and a shorter curved and less acute lateral one, on each side; the inner lateral teeth are short, strongly incurved, with a longer acute central denticle and a smaller outer one, and with the inner angle of the base slightly prominent; the next to the outer lateral teeth (fig. 6, *c*) are much longer, broad, tapered, curved, acute; the outer teeth (fig. 6, *d*) are longer, more slender, more curved, triquetral, and very acute with a large basal lobe. A row of thin, distinct, roundish scales (fig. 6, *e*) forms a border, outside the teeth.

The pen is thin, translucent, pale yellowish, in fresh specimens, but brownish or amber-color in alcoholic specimens. It has a short, narrow, anterior shaft and a long, very thin, lanceolate blade, which is concave beneath, especially posteriorly, for the edges curve downward, but are not involute; the posterior tip is acute, slightly thickened and curved downward, so that the posterior end is shaped something like the forward part of a shallow canoe. In the male the pen is relatively longer and the blade narrower than in the female. The extreme anterior end is thin and flexible, and rather abruptly pointed, being shaped like a pen; the shaft is rather stiff, with a strong, regularly rounded keel, convex above and concave beneath; outside of the keel the marginal portion curves outward and then upward, so that its convex surface is below, and the edge slightly turns up. The shaft, with its central keel and marginal ridges, extends to the posterior tip of the pen, decreasing regularly in width beyond the commencement of the blade. The blade is at first very narrow, and gradually increases in width; it is marked by numerous slightly thickened ridges, which diverge from the central line as they extend backward; the edges are very thin.

In the larger males the proportion of the greatest breadth of the blade to the total length of the pen varies from 1 : 7·50 to 1 : 9·36. In the females it varies from 1 : 5·60 to 1 : 6·10.

The following description of the colors was made from a freshly caught, adult, male specimen (1 G); taken in New Haven Harbor, May 18, 1880.

Upper surfaces of the body, head and caudal fin thickly covered with rather large chromatophores, which are mostly rounded or nearly circular, except along the middle of the back, where they are more crowded and darker, and mostly have a long-elliptical form (perhaps accidental).

The chromatophores, when expanded, are light red to dark lake-red, varying to purplish red and pink; when contracted to small points, they become brownish purple.

On the head, behind the middle of the eyes, and toward the margin of the caudal fin, the spots are smaller and less numerous, the intervening bluish white ground-color showing more largely. Over most of the dorsal surface the chromatophores are arranged more or less evidently in circular groups; usually the central chromatophore is a large, round, dark purplish spot; this is surrounded by a circular space of whitish ground-color; and by a circle of roundish chromatophores, mostly of different shades of lake-red and pink, and a deeper lying circle of pale canary-yellow ones. On the lower side they are so thinly scattered that they leave much of the translucent bluish white ground-color visible between them; along the median ventral line the spots are more numerous, producing a distinct median stripe. The caudal fin is clear bluish white beneath, and very translucent, becoming almost transparent near the margin.

Exposed part of the siphon similar to the ventral surface of the body, but with the spots more sparse, and mostly disappearing near the margin and at the base; lower side of the head, in front of the eyes, sparsely spotted. Outer and upper sides of the upper arms, and outer surfaces of the ventral pair similarly, but somewhat more densely, specked; both sides of the ventral arms and lower sides of the lateral arms pinkish white and unspotted. Tentacular arms pale translucent, bluish white, with the outer surface, except at base, rather thinly specked with small purplish chromatophores; the inner surface and upper side of the tip and the suckers are translucent white; rings of suckers white.

On the inner surface of the dorsal and lateral arms, between the suckers, there are a few large chromatophores, and a double row of them runs out obliquely on the muscular thickenings of the marginal membrane, alternating with the suckers, on each side; suckers pure translucent, bluish white (becoming yellow or brown in alcohol).

The pupils of the eyes are deep bluish black; on the upper side they are encroached upon by a sinuous, downward extension of the iris, which is silvery or pearly white, with brilliant, green, opalescent reflections at the upper margin.

Sexual differences.

The sexes differ to a considerable extent, in proportions. If we compare specimens of equal length, the female will have the body relatively stouter and less tapered posteriorly than the male; the head is decidedly larger;* the arms are longer; the suckers are usually distinctly larger, especially those of the tentacular arms. But if we compare specimens having the head and arms of equal size, the male will be found to have a decidedly longer, more slender and more tapered body, and a somewhat longer and narrower fin. (See table B, for comparative proportions.)

In the adult male the circumference of the head to the mantle-length usually varies from 1 : 2·55 to 3·45, averaging about 1 : 3·10; in the female from 1 : 1·75 to 1 : 2·45, averaging about 1 : 2·25.

The ratio of the breadth of the fin to the mantle-length, in the male, varies from 1 : 2·12 to 1 : 2·45, averaging about 1 : 2·25; in the female, from 1 : 1·70 to 1 : 2·12, averaging about 1 : 1·90.

The ratio of the diameter of the largest tentacular suckers to the mantle-length varies, in the male, from 1 : 50 to 1 : 90, averaging about 1 : 65; in the female it varies from 1 : 36 to 1 : 54, averaging about 1 : 45.

The proportion of the length of the dorsal arms to the mantle-length, in the male, averages about 1 : 3·50; in the female about 1 : 2·75.

The most marked effect of strong alcohol is to reduce the diameter of the body and the breadth of the caudal fin to a proportionally far greater extent than it does the length of the mantle and fin. Therefore, specimens that have been preserved in too strong alcohol often look like a different species, and the females often resemble the males, on account of their apparently longer and narrower fins and unnaturally slender bodies.

The pen of the female is relatively broader and shorter than that of the male (see table A).

* Some of the nominal European species of *Loligo*, that have been based on the smaller size of the head, arms, and suckers are probably only the males of the common species. The sexual variations in this genus have apparently been very imperfectly understood by European writers generally.

The best and most positive external characters for distinguishing the sexes, are the hectocotylized condition of the left ventral arm of the male, near the tip (Plate XXIX, fig. 3, 3*a*); and the presence, in the female, of a horse-shoe shaped sucker, or place for attachment of the spermatophores, on the inner buccal membrane, below the beak (fig. 4, *s*). These characters, however, are not present in the very young individuals, and in those with the mantle two or three inches long they appear only in a very rudimentary state.*

A.—*Sexual variations in the pen.* (*Measurements in inches*).

	♂ P.	♂ 9V.	♂ 10V	♂ W.	♀ E.	♀ EE.	♀ 17V	♀ An.
Length of pen	10·50	10·20	9·55	8·50	7·75	7·65	7·55	7·50
Length of shaft	1·40	2·10	2·20	2·00	2·00	1·10	1·50	1·50
Length of blade	9·10	8·10	7·35	6·50	5·75	6·55	6·05	6·00
Breadth of shaft	·50	·35	·40	·40	·15	·38	·35	·35
Breadth of blade	1·40	1·15	1·02	·98	1·00	1·35	1·25	1 30
Proportions:								
Greatest breadth to length, 1:	7·50	8·86	9·36	8·67	7·75	5·66	6.04	5·76

The specimen marked An. is from Cape Ann, Mass. (*var. borealis*); that marked ♀ E., is *var. pallida* from Astoria, N. Y.; the rest are from Vineyard Sound, Mass.

The adult males have the left ventral arm conspicuously hectocotylized (Plate XXIX, figs. 3, 3*a*) by an alteration and enlargement of the sucker-pedicels and a decrease in the size of the cups of the suckers, some of which usually disappear entirely, especially in the outer row. The modification commences at about the 18th to 20th sucker, by the swelling of the bases of the pedicels; on succeeding suckers this rapidly becomes more marked and the swollen bases of the pedicels become more elongated and gradually become compressed transversely, while the size of the cups rapidly decreases till at about the 28th to 30th they are very minute and rest at the summits of the large, flattened, acute-triangular supports; from the 30th to 35th the cups usually become mere rudiments or disappear, in large males; beyond this the cups again grow larger and the pedicels decrease in size, till the small suckers become normal on the tip of the arm. About twenty-five to thirty of the suckers of the outer row are thus

* Professor Steenstrup formerly advanced the opinion that the males of *Octopus* and other genera of Cephalopods were provided with the hectocotylized arm from the first, but this we have not found to be the case. The hectocotylized condition of the arm in *Loligo* is developed in proportion to the development of the internal sexual organs, and is first distinctly noticeable in the larger of the young ones taken in autumn, and in the spring, in the young ones that have survived their first winter.

modified in the larger males. Of the inner row, a somewhat smaller number of suckers show distinct alteration, and these are less extensively altered; their pedicels are swollen and their cups reduced, but not to so great an extent, and usually none of the cups are entirely absent.

In young males, with the mantle about 70^{mm} to 90^{mm}, (young of the previous year, or perhaps of the first year, when three to five months old,) these modifications of the suckers begin to appear, at first very indistinctly, by a slight enlargement of the bases of the pedicels and a scarcely noticeable decrease in the size of the cups. In specimens with the mantle 100^{mm} to 130^{mm} long (probably young of the previous year, nine months to a year old) the modification of the suckers, though much less marked than in the adults, is sufficiently distinct, the pedicels having become distinctly longer and stouter, while the cups are evidently reduced in size, but none of them are abortive in such specimens.

Loligo Pealei, var. borealis Verrill.

PLATE XXXVII, FIGURE 2 (pen). PLATE XLI, FIGURE 1, (anatomy).

Since this variety was described I have had opportunities to examine a much larger series of specimens from Cape Ann. These show very plainly that this form passes by intermediate gradations, into the typical form, so that it cannot be considered as anything more than a local or geographical variety. The differences in the proportion of the fin to the mantle, noticed in the original specimens, do not hold good, with a larger series. The only varietal character, of much importance, is the relatively smaller suckers, and this is much less marked in most of the later examples than in the former ones, and is a character that varies greatly in the specimens from every locality.*

In the original specimens the 'pen' (Pl. XXXVII, fig. 2) while having the general form of that of *L. Pealei*, tapers more gradually anteriorly, and has a narrower, more tapered, sharper and stiffer anterior tip. The variations in proportion are sufficiently indicated by the measurements given in tables A, B and C, in which those specimens designated as 2 G. to 5 G. were measured while fresh. The one marked An. ♀ is from the lot originally described as variety *borealis*, and illustrates the abnormally small size of the suckers.

* Probably those with abnormally small tentacular suckers are instances in which the arms, the clubs, or the suckers have been lost and afterwards reproduced, as explained below.

Loligo Pealei, var. pallida Verrill.

PLATE XXXIV, FIGURES 1–4. PLATE XXXVII, FIGURES 9–11, (suckers). PLATE XL, FIGURE 1, (anatomy).

This geographical variety or sub-species is distinguished from the typical form chiefly by its shorter and stouter body, in both sexes, its broader and larger caudal fin, and the larger size of the suckers, especially those of the tentacular club.

The caudal fin is broad-rhomboidal, often as broad as long, or even broader than long, in adult specimens. The ratio of the breadth of the fin to the mantle-length, in the larger specimens (with mantle 150^{mm} to 225^{mm} long) is, in the males, from 1 : 1·75 to 1 : 2·00, while in *L. Pealei*, of corresponding size, the ratio is 1 : 2·15 to 1 : 2·30; in the females of *var. pallida*, of similar size, the ratio varies from 1 : 1·45 to 1 : 1·75 (see tables F, G). Tentacular arms long and slender, varying in length according to the amount of contraction, in extension longer than the body, the club or portion that bears suckers forming about one-third the whole length. In a few males the larger suckers on the middle of this portion are not so large as the largest on the other arms, but usually they are twice as large. In some females the principal suckers of the tentacular arms are very much larger than in others, and considerably exceed those of the males of equal length; they form two alternating rows, of eight to ten each, along the middle of the club; external to them there is a row of smaller suckers alternating with them on each side; the suckers toward the tips are very numerous, small and crowded in four rows; at the tip there is a group of about twenty minute, smooth-edged suckers, in four rows. Outside of the suckers, on each side, there is a broad marginal membrane, having the edges scalloped and strengthened between the scallops by strong, transverse, muscular ridges; another membranous fold runs along the back side, expanding into a broad membranous keel or crest near the end. The arms of the ventral pair are intermediate in length between those of the second and third pairs.

Ground-color of the body, head, arms and fins, pale, translucent yellowish white; the upper surface is covered with pale brown, unequal, circular spots, which are not crowded, having spaces of whitish between them; the spots are more sparse on the head and arms, but somewhat clustered above the eyes; entire ventral surface pale, with small, distant, brownish, circular spots, which are nearly obsolete on the siphon and arms. The general appearance of the animal, when fresh, is unusually pale and gelatinous. The pen is broad, quill-shaped, translucent and amber-colored.

A medium-sized male specimen, recently preserved in alcohol, measured 145^{mm} from the base of the dorsal arms to the posterior end of the body; length of body, 120^{mm}; length of caudal fin, 70^{mm}; breadth of fin, 75^{mm}; length of first pair of arms, 42^{mm}; of second pair, 50^{mm}; of third, 60^{mm}; of ventral pair, 53^{mm}; of tentacular arms, 150^{mm}. (For other measurements see tables B to E.)

Astoria, Long Island, 1870, (Robert Benner).

This form has been received, hitherto, only from the western part of Long Island Sound, where it is abundant with the schools of menhaden, on which it feeds.

Reproduction of lost parts.

I have observed in this species, as well as in *Ommastrephes illecebrosus*, numerous instances in which some of the suckers have been torn off and afterwards reproduced. In such examples new suckers of various sizes, from those that are very minute up to those that are but little smaller than the normal ones, can often be found scattered among the latter, on the same individual. It seems to me possible that some of the specimens having the suckers on the tentacular arms unusually small, may have reproduced all those suckers, or still more likely, the entire arm.

I have seen specimens of this species, and also of *O. illecebrosus*, which, after having lost the tips, or even the distal half of one or more of the sessile arms, have more or less completely reproduced the lost parts.* In such cases the restored portion is often more slender and has smaller suckers than the normal arms, and where the old part joins the new there is often an abrupt change in size. Probably this difference would wholly disappear, after a longer time.

An unquestionable and most remarkable example of the reproduction of several entire arms occurs in a small specimen taken off Newport, R. I., Aug., 1880. This has the mantle 70^{mm} long; dorsal arms 22^{mm}, 3d pair of arms 30^{mm}. The three upper pairs of arms are perfectly normal, but both the tentacular and both the ventral arms have evidently been entirely lost and then reproduced, from the very base. These four arms are now nearly perfect in form, but are

* Perhaps the *Dosidicus Eschrichtii* Steenstrup is only an *Ommastrephes* or *Sthenoteuthis* which had lost and partially reproduced the tips of all the arms. Aside from the solid cone of the pen, characters have not been given sufficient to distinguish it generically. My former reference of this species (p. 250) to the *Teuthidæ*, was an error, due to the brevity of the original description.

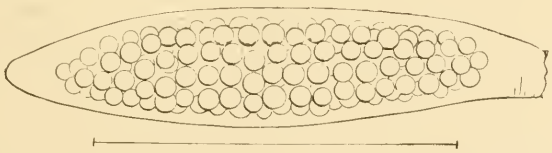
scarcely half their normal size on the left side, and still smaller on the right side. The left tentacular arm is only 24^{mm} long, and very slender, but it has the normal proportion of club, and the suckers, though well formed, are diminutive, and those of the two median rows are scarcely larger than the lateral ones, and delicately denticulated. The right tentacular arm is less than half as long (12^{mm}) being of about the same length as the restored ventral one of the same side; it is also very slender and its suckers very minute and soft, in four equal rows. The right ventral arm is only 14^{mm} long; the left one 15^{mm} long; both are provided with very small but otherwise normal suckers.

In another specimen from Vineyard Sound, a female, with the mantle about 150^{mm} long, one of the tentacular arms had lost its club, but the wound had healed and a new club was in process of formation. This new club is represented by a small tapering acute process, starting out obliquely from the stump, and having a sigmoid curvature; its inner surface is covered with very minute suckers. The other arms are normal.

Eggs and Young.

The eggs are contained in many elongated, fusiform, gelatinous capsules (cut 3), which are attached in clusters by one end to seaweeds or some other common support; from the point of attachment

3.



they radiate in all directions. These clusters are often six or eight inches in diameter, containing hundreds of the capsules, which are mostly from two to three inches long and filled with numerous eggs, the number varying from 20, or less, up to about 200. The transparent eggs are arranged, in the well-formed capsules, in six or more rows and are so closely crowded that they touch each other and often take polygonal forms, especially when preserved.

How many of these capsules are deposited by one female is very uncertain. Probably several females are concerned in the formation of the larger clusters. The eggs are mostly laid in June and July, but many are laid in August, and some even in September. By the

11th of June, in the vicinity of New Haven, many of these eggs contain embryos in advanced stages of development (Plate XLI, figs. 2, 3; Plate XLV, fig. 4). The embryos, before hatching, can swim around inside the eggs.

These embryos are very beautiful objects to observe under the microscope.

Even at this early period some of the chromatophores are already developed in the mantle and arms, and during life, if examined under the microscope, these orange and purple vesicles can be seen to contract and expand rapidly and change colors, as in the adult, but the phenomena can be far more clearly seen in these embryos owing to the greater transpareney of the skin. In the young the chromatophores are very regularly and symmetrically arranged, on the arms, head, and mantle. At this stage of development the eyes are brown. In these embryos a remnant of the yolk-sac (*y*), appears to protrude from the mouth, but it is really connected with the space around the mouth and pharynx, and into this it is eventually absorbed.

The more advanced of the embryos were capable of swimming about, when removed from the eggs, by means of the jets of water from the siphon (*s*), which is developed at an earlier stage. The arms (a''-a'''') are then short, blunt, very unequal, with few minute suckers; the dorsal arms are very small, while those of the 2d and 3d pairs are successively longer, and have distinct suckers; the tentacular arms (a''') are longer and larger than any of the others, and have larger suckers, which already, in some examples, can be seen to form four rows; the ventral arms (a'''',) are about as long as the 2d pair, and bear several suckers. The mantle (*m*) is short, and the caudal fins (*f*) are very small, short, lateral, and separately attached to each side of the blunt posterior end of the body, thus recalling their adult condition in *Rossia*. The eyes (*e*) are large and prominent; the rudimentary beak (*d*) and odontophore (*l*) are distinctly visible. The two otoliths (*o*) are very distinctly visible, as highly refracting ovate bodies, above the basal part of the siphon, one on each side. The ink-sac (*i*), attached to the rectum (*t*), is conspicuous on account of its dark color; the gills (*g*) are provided with a small number of transverse processes; the heart (*h*) and the branchial auricles (h' h') are easily seen, while they continue to pulsate. The pen exists only in a rudimentary condition, as a thin cartilage.

During July and August the young (fig. 5) from less than a quarter of an inch to an inch or more in length, swim free at the surface, and may often be taken in immense quantities with towing

nets. They were particularly abundant in the summers of 1871 and 1873, in Vineyard Sound.

These young squids are devoured in inconceivable numbers by fishes of many kinds, and also by the adult squids of the same species, and by the larger jelly-fishes, and many other marine animals. The larger sizes, and even the adults, are also greedily devoured by blue-fish, black-bass, striped-bass, weak-fish, mackerel, cod, and many other kinds of fishes. Therefore these "squids" are really of great importance as food for our most valuable market fishes. They are extensively used as bait by the fishermen.

Rate of Growth.

I am not aware that any definite information has hitherto been published as to the rate of growth or length of life of any of our Cephalopods. By some writers it has been stated that the squids are all annual, but this seems to be a mere assumption, without any evidence for its basis.

Therefore, I have, for several years past, preserved large numbers of specimens of the young of *Loligo Pealei*, collected at different seasons and localities, in order to ascertain, if possible, the rate of growth and the size acquired during the first season, at least. One of the following tables (I) shows some of the data thus obtained.

There is considerable difficulty in ascertaining the age of these squids, owing to the fact that the spawning season extends through the whole summer, so that the young ones hatched early in June are as large by September as those that hatch in September are in the following spring. Owing to the same cause, most of the large lots of young squids taken in mid-summer include various sizes, from those just hatched up to those that are two or three inches long. They are often mixed with some of those of the previous year, considerably larger than the rest. Earlier in the season (in May and the first part of June), before the first-laid eggs begin to hatch, the youngest specimens taken (60 to 100^{mm} long) are presumed to belong to the later broods of the previous autumn, while those somewhat larger are believed to be from earlier broods of the previous summer, and to represent the growth of one year, very nearly.

Taking these principles as a guide, I have arrived at the following conclusions, from the data collected:

1. The young squids begin to hatch at least as early as the second week in June, on the southern coast of New England, and continue to hatch till the middle of September, and perhaps later.

2. By the second week in July, the first hatched of the June squids have grown to the size in which the body (or mantle) is 30 to 48^{mm} long; but these are associated with others that are younger, of all sizes down to those just hatched. But they begin to show a disposition to go in "schools" composed of individuals of somewhat similar sizes.

3. By the second week in August, the largest June squids have become 50 to 68^{mm} in length of body, and the later broods are 5 to 30^{mm} long. As before, with these sizes occur others of all ages down to those just hatched. It should be observed, however, that in those of our tabulated lots taken by the trawl, the very small sizes are absent, because they pass freely through the coarse meshes of the net.

4. By the second week in September, the June squids have the mantle 60 to 82^{mm} long. All the grades of smaller ones still abound. A few larger specimens, taken the last of August, and in September, 84 to 110^{mm} long, may belong to the June brood, but they may belong to those of the previous autumn.

5. In the first week of November, the larger young squids taken had acquired a mantle length of 79 to 85^{mm}, but these are probably not the largest that might be found. Younger ones, probably hatched in September and October, 8 to 20^{mm} in length of body, occurred in vast numbers Nov. 1, 1874. The specimens taken November 16, off Chesapeake Bay, having the mantle 70–90^{mm} long, probably belong to the schools hatched in summer.

6. In May and June the smallest squids taken, and believed to be those hatched in the previous September or October, have the mantle 62 to 100^{mm} long. With these there are others of larger sizes, up to 152 to 188^{mm}, and connected with the smaller ones by intermediate sizes. All these are believed to belong to the various broods of the previous season. In these, the sexual organs begin to increase in size and the external sexual characters begin to appear. The males are of somewhat greater length than the females of the same age.

7. In July, mingled with the young of the season, in some lots, but more often in separate schools, we take young squids having the mantle 75 to 100^{mm} long. These we can connect by intermediate sizes with those of the previous year, taken in June. I regard these as somewhat less than a year old.

8. Beyond the first year it becomes very difficult to determine the age with certainty, for those of the first season begin, even in the autumn, to overlap in their sizes those of the previous year.

9. It is probable that those specimens which are taken in large quantities, while in breeding condition, during the latter part of May and in June, having the mantle 175 to 225^{mm} long in the females and 200 to 275^{mm} long in the males, are two years old.

10. It is probable that the largest individuals taken, with the mantle 300 to 425^{mm} long, are at least three years, and perhaps, in some cases, four years old. The very large specimens generally occur only in small schools and are mostly males. The females that occur with these very large males are often of much smaller size, and may be a year younger than their mates.

11. When squids of very different sizes occur together, in a school, it generally happens that the larger ones are engaged in devouring the smaller ones, as the contents of their stomachs clearly show. Therefore it is probable that those of similar age keep together in schools for mutual safety.

12. Among the adult specimens of *var. pallida*, taken in autumn, at Astoria, there are several young ones, from 75 to 120^{mm} in length, with rudimentary reproductive organs. These may, perhaps, be the young of the year, hatched in June.

Distribution.

This species is found along the whole coast, from South Carolina to Massachusetts Bay.

It is the *common squid* from Cape Hatteras to Cape Cod. In Long Island Sound and Vineyard Sound it is very abundant, and is taken in large numbers in the fish-pounds and seines, and used, to a large extent, for bait. It is comparatively scarce, though not rare, north of Cape Cod. The young were trawled by us in many localities, in Mass. Bay, in 1878. Large specimens were taken in the pounds at Provincetown, Mass., August, 1879. It was taken in considerable quantities, in breeding condition, in the fish-pounds on Cape Ann, near Gloucester, Mass., May, 1880, (*var. borealis*). It has not been observed north of Cape Ann. Its southern limit is not known to me, but it appears to have been found on the coast of South Carolina.

In depth, it has occurred from low-water mark to fifty fathoms. The eggs have often been taken by us in the trawl, in great abundance, at many localities along the southern shores of New England, in five to twenty-five fathoms.

It is known to be a very important element in the food-supply of the blue fish, tautog, sea-bass, striped bass, weak-fish, king-fish, and many other of our larger market fishes.

B.—*Table to show sexual variations.* (*Measurements in inches.*)

Loligo Pealei ♂ and ♀.	♂ 1G	♂ 4V	♂ 6V	♂ 5V	♂ *a'*	♂ 9V	♂ 8V	♂ 10V	♀ 13V	♀ 1V	♀ 12V	♀ 2V	♀ 11V	♀ 5G	An. ♀	♀ 17V
Length to dorsal mantle edge	12·00	11·70	11·50	11·40	11·00	10·30	10·00	9·55	10·00	9·40	8·62	8·30	8·25	8·00	7·30	7·75
Length to base of dorsal arms	13·80	13·00	12·50	12·50	12·00	11·50	10·90	10·60	11·40	10·50	9·75	9·50	9·75	9·35	8·20	9·25
Length of dorsal arms	3·50	3·15	3·10	3·30	3·25	3·40	2·80	2·70	3·60	3·40	2·82	3·30	3·15	3·10	--	2·80
Length of caudal fin	7·90	7·40	7·00	7·10	7·00	6·20	6·10	5·30	6·35	6·20	5·50	5·10	4·75	4·80	4·50	4·80
Breadth of caudal fin	5·00	4·90	5·00	4·90	5·00	4·80	4·70	4·15	4·75	4·60	4·50	4·80	4·60	4·10	4·00	4·35
Breadth between insertions	1·70	1·10	1·20	1·30	1·50	1·12	1·00	·95	1·50	1·30	0·37	1·40	1·30	1·50	1·15	1·03
Breadth of body	--	1·75	1·90	1·70	1·80	--	1·70	1·10	1·90	1·85	1·70	2·00	1·75	--	1·20	1·45
Circumference of body	6·00	4·90	5·50	5·30	5·70	5·50	4·90	4·90	5·75	5·50	5·40	5·50	5·15	4·70	--	4·85
Breadth of head, at eyes	1·50	1·50	1·30	1·40	1·50	1·42	1·20	1·18	1·60	1·50	1·58	1·40	1·55	1·40	1·40	1·30
Circumference of head, in front of eyes	--	3·70	3·40	3·50	4·30	3·50	2·90	2·30	4·25	4·75	3·80	--	3·55	--	--	3·15
Diameter of largest tentacular suckers	·18	·19	·16	·18	·22	·20	·11	·11	·23	·20	·19	·21	·19	·15	·08	·15
Diameter of largest of 3d pair of arms	·11	·12	·12	·12	·11	·11	·08	·11	·15	·13	·13	·16	·12	·11	·06	·10
Length of pen	--	--	--	--	--	10·20	--	9·55	--	--	--	--	--	--	--	7·55
Breadth of pen	--	--	--	--	--	1·15	--	1·09	--	--	--	--	--	--	--	1·25
Proportions:																
Fin-length to mantle-length 1 :	1·51	1·58	1·64	1·60	1·57	1·66	1·63	1·79	1·57	1·51	1·56	1·60	1·73	1·66	1·62	1·61
Fin-breadth to mantle-length 1 :	2·40	2·38	2·30	2·32	2·20	2·14	2·12	2·28	2·10	2·04	1·91	1·72	1·79	1·95	1·82	1·79
Breadth to length of fin 1 :	1·58	1·51	1·40	1·44	1·40	1·29	1·29	1·27	1·34	1·34	1·22	1·06	1·03	1·17	1·12	1·10
Circum. of body to mantle-length 1 :	2·00	2·38	2·09	2·15	1·92	1·89	2·04	1·93	1·74	1·70	1·59	1·50	1·60	1·70	--	1·60
Circum. of head to mantle-length 1 :	--	3·11	3·38	3·25	2·55	2·94	3·44	4·13	2·35	1·98	2·26	--	2·32	--	--	2·46
Diam. large tent. suckers to length 1 :	66·66	61·04	71·87	63·33	50·00	51·50	90·90	86·36	43·50	47·00	45·36	39·52	43·42	53·33	91·25	51·66
Length of dorsal arms to length 1 :	3·43	3·71	3·70	3·45	3·38	3·01	3·57	3·51	2·78	2·76	3·05	2·51	2·61	2·58	--	2·77

The specimens in this table were selected from those that are best preserved. 1G is from New Haven, measured while fresh; 1V to 17V are from Vineyard Sound, recently preserved and in good condition; *a'* is from Noank, Conn.; 5G is from Cape Ann, Mass., measured before preservation; An. is a specimen from Cape Ann; the latter and 8V, 10V have abnormally small suckers.

C.—*Table illustrating variations due to growth, sex, locality and state of preservation.* (*Measurements in inches.*)

Loligo Pealei ♂ and ♀. Typical form and *var. borealis.*	♂ A 1.	♂ 1 G.	♂ *a'*.	♂ *c'*.	♂ 6 V.	♂ 3 G.	♂ 2 G.	♂ *b'*.	♂ 4 G.	♀ 5 G.	♀ *g'*.	♀ An.
Tail to tip of dorsal arms	20·75	17·30	15·20	15·75	15·50	15·20	14·70	14·60	13·10	12·20	9·75	10·20
Tail to tip of 2d pair arms	21·25	17·70	15·50	16·00	16·00	16·00	15·10	14·80	13·70	12·60	10·05	10·50
Tail to tip of 3d pair arms	21·75	18·00	16·00	15·70	16·50	16·30	15·80	15·30	--	13·40	10·50	10·85
Tail to tip of 4th pair arms	21·05	17·40	15·30	16·00	15·75	16·00	15·10	15·10	14·10	12·70	10·00	10·50
Tail to tip of tentacular arms	24·50	23·00	17·50	20·00	20·50	20·50	19·00	16·90	13·20	15·00	12·50	13·50
Tail to base dorsal arms	17·25	13·80	12·00	12·75	12·50	12·30	11·90	·90	10·10	9·35	8·00	8·20
Tail to center of eye	·25	12·60	11·20	12·00	11·70	11·75	11·00	10·70	9·50	8·75	7·20	7·50
Tail to mantle edge, above	16·25	12·00	11·00	11·00	11·50	11·00	10·50	10·60	8·90	8·00	7·20	7·30
Tail to mantle edge, below	15·00	11·00	10·25	--	10·50	10·25	9·75	9·75	--	7·30	6·55	6·70
Tail to insertion of fin	9·80	7·90	7·00	7·00	7·00	6·90	6·50	6·60	5·40	4·80	4·35	4·50
Tail to outer angle of fin	7·00	5·50	4·75	5·00	--	4·80	4·40	4·50	3·75	3·50	3·15	3·30
Breadth of fin	6·85	5·00	5·00	5·00	5·00	4·90	4·50	4·80	4·30	4·10	3·80	4·10
Between insertion	2·10	1·70	1·50	1·20	1·20	1·20	1·30	1·48	1·40	1·50	1·20	1·15
Outer angle to insertion	4·60	3·25	3·40	3·00	--	3·50	3·20	3·25	2·75	2·70	2·25	2·50
Circumference of body	7·20	6·00	5·70	--	--	4·40	4·75	5·30	4·10	4·20	4·25	4·80
Breadth of head, at eyes	1·75	1·50	1·50	1·35	1·30	1·30	1·30	1·30	1·40	1·40	1·20	1·40
Breadth of siphon, at cartilages	1·30	1·15	1·18	·98	--	--	1·05	1·10	1·95	--	·80	--
Aperture of siphon	·45	·35	·40	·40	--	--	·35	·40	·30	--	--	--
Length of dorsal arms	3·70	3·50	3·25	3·00	3·10	3·25	2·90	3·10	3·00	3·10	2·00	2·20
Length of 2d pair arms	4·20	4·10	3·50	3·20	3·40	3·50	3·30	3·35	3·50	3·30	2·30	2·50
Length of 3d pair arms	4·40	4·30	4·00	3·35	3·90	3·75	3·80	3·80	3·90	4·10	2·60	2·85
Length of 4th pair, from base	4·10	3·80	3·35	3·25	3·40	3·60	3·40	3·30	3·30	3·60	2·40	2·70
Length of tentacular arms	7·10	9·25	5·25	7·00	7·25	8·00	7·00	5·50	7·50	8·50	4·40	6·10

TABLE C.—*Continued.* (*Measurements in inches.*)

Loligo Pealei ♂ and ♀. Typical form and *var. borealis.*	♂ A 1.	♂ 1 G.	♂ *a'*.	♂ *c'*.	♂ 6 V.	♂ 3 G.	♂ 2 G.	♂ *b'*.	♂ 4 G.	♀ 5 G.	♀ *g'*.	♀ An.
Length of tentacular club	2·90	2·80	2·60	2·00	2·40	2·60	2·50	2·55	2·50	2·50	1·50	1·85
Breadth of tentacular club	·90	·40	·75	·40	·50	·40	·35	·60	·40	·40	·35	·30
Breadth of dorsal arms	·35	·30	·31	·28	·24	--	·20	·27	--	--	·20	·23
Breadth of 2d pair arms	·50	·35	·33	·30	·34	--	·30	·37	--	--	·30	·33
Breadth of 3d pair arms	·50	·40	·45	·41	·35	--	·33	·43	--	--	·27	·30
Breadth of 4th pair arms	·40	·35	·35	·32	·35	--	·32	·30	--	--	·28	·28
Breadth of tentacular arm	·30	·15	·20	·20	·17	--	·12	·20	--	--	·18	·15
Diameter of eye (external)	1·20	1·10	1·00	--	--	·80	·80	1·00	·65	·65	--	--
Diameter of suckers:												
Largest of tentacular arms	·25	·18	·22	--	·16	·17	·15	·20	·19	·15	·12	·12
Largest of dorsal arms	·13	·08	·11	--	·10	·09	·09	·10	--	·10	·07	--
Largest of 2d pair arms	·15	·11	·13	--	·11	·11	·10	·12	--	·11	·10	--
Largest of 3d pair arms	·15	·11	·14	--	·12	·11	·11	·13	·10	·11	·10	·10
Largest of 4th pair arms	·12	·08	·10	--	·08	·08	·07	·09	·06	·08	·06	--
Proportions:												
Fin-length to mantle 1:	1·65	1·51	1·57	1·57	1·64	1·59	1·61	1·60	1·64	1·66	1·65	1·62
Fin-breadth to mantle-length 1:	2·37	2·40	2·20	2·20	2·30	2·24	2·33	2·20	2·06	1·95	1·89	1·78
Fin-breadth to fin-length 1:	1·43	1·58	1·40	1·40	1·40	1·40	1·44	1·37	1·25	1·17	1·14	1·09
Dorsal arm to mantle 1:	4·39	3·42	3·38	3·66	3·70	3·38	3·60	3·38	2·96	2·58	3·60	3·31
Circumference of body to length 1:	2·25	2·00	1·92	--	--	2·50	2·20	2·00	2·17	1·90	1·69	1·52

A 1, typical form from Cape Cod, the largest specimen seen; An., *g'*, 2 G to 5 G, = *var. borealis*, from Cape Ann, Mass.; *a'*, *b'*, from Noank, Conn., typical; 6 V, from Vineyard Sound, Mass.; *c'*, typical, from New Haven. Those marked 1 G to 5 G were measured while fresh; the rest, after preservation in alcohol.

D.—*Table illustrating variations in the males, due mostly to age, and mode of preservation.* (*Measurements in inches.*)

Loligo Pealei (♂)	Y.	X.	Z.	R.	Q.	B.	E.	D.	S.	P.	G.	*oo.*	H.	J.	F.	*k.*	O.
Tail to end of longest sessile arms	16·70	16·15	16·30	15·25	14·81	--	14·00	13·65	13·20	14·00	12·40	12·80	12·75	12·30	11·80	12·00	10·90
Tail to mantle edge, above	12·00	12·30	11·30	11·30	10·75	10·50	10·50	10·00	9·90	10·10	9·65	9·15	9·10	9·15	8·90	8·30	8·25
Tail to mantle edge, below	10·7	11·00	9·35	10·40	9·30	9·75	9·80	--	8·80	9·00	8·10	8·40	8·20	8·50	8·20	7·25	7·50
Tail to insertion of fin	7·50	7·90	6·70	6·80	6·90	6·60	6·50	6·35	6·30	6·50	5·80	5·70	5·65	5·60	5·50	5·00	4·95
Tail to eye	12·40	11·60	12·00	11·50	10·91	--	10·40	10·15	9·50	10·30	9·20	9·30	9·20	9·20	8·90	8·40	8·00
Tail to base of dorsal arms	13·10	11·90	12·75	12·10	11·50	--	11·00	11·00	10·50	11·10	9·95	9·70	9·95	9·95	9·60	9·20	8·60
Eye to end of dorsal arms	3·75	3·80	3·20	2·80	3·40	--	3·40	2·80	3·40	3·30	2·70	3·20	3·15	2·50	2·50	3·10	2·55
Eye to end of 2d pair arms	3·95	4·10	3·90	3·10	3·55	--	3·60	3·15	3·50	3·55	2·90	3·40	3·20	2·80	2·80	3·30	2·80
Eye to end of 3d pair arms	4·30	4·55	4·30	3·70	3·90	--	4·00	3·50	3·70	4·10	3·20	3·50	3·35	3·11	2·90	3·60	2·90
Eye to end of ventral arms	4·15	4·30	4·00	3·40	3·60	--	3·50	3·20	3 40	4·10	3·00	3·20	3·30	2·90	2·80	3·20	2·70
Eye to end of tentacular arms	7·10	7·80	7·60	6·25	5·60	--	5·00	5·00	5·50	7·00	4·40	4·90	4·65	4·75	5·00	6·80	4·70
Breadth of head, across eyes	1·55	1·65	1·45	1·65	1·35	1·30	1·50	1·30	1·30	1·75	1·10	1·30	1·20	1·28	1·25	1·10	1·05
Breadth of head, in front of eyes	--	1·45	1·40	1·50	1·35	--	1·15	--	1·20	1·40	·80	1·25	1·05	1·05	1·05	1·00	1·00
Breadth of body	--	1·75	1·70	2·70	1·70	1·75	1·60	--	2·60	1·50	1·40	1·60	1·30	1·50	1·40	1·50	1·15
Breadth of fins	5·50	5·45	5·60	5·25	5·10	4·50	4·30	4·20	4·30	5·30	4·00	4·20	4·25	4·10	4·25	3·50	3·80
Circumference of body	5·45	5·40	5·00	5·15	4·80	-	4·75	4·60	4·80	5·10	4·00	4·75	3·85	4·50	4·25	4·50	3·70
Length of tentacular club	2·60	3·85	2·20	2·25	2·00	2·55	1·80	1·75	5·80	2·20	1·60	2·10	1·75	1·70	1·40	1·90	1·30
Proportions:																	
Length of fin to mantle, 1:	1·60	1·55	1·68	1·66	1·55	1·50	1·61	1·67	1·57	1·56	1·66	1·60	1·61	1·62	1·61	1·66	1·66
Breadth of fin to mantle, 1:	2·18	2·25	2·01	2·15	2·10	2·33	2·44	2·40	2·30	1·90	2·41	2·17	2·14	2·23	2·09	2·37	2·17
Breadth of fin to its length, 1:	1·36	1·44	1·19	1·30	1·35	1·46	1·51	1·51	1·46	1·23	1·45	1·35	1·32	1·36	1·29	1·42	1·30

TABLE D.—*Continued.* (*Measurements in inches.*)

Loligo Pealei (♂)	I.	L.	M.	N.	T.	*a''*.	W.	K.	*f*.	*g*.	*h*.	V.	*b''*.	*c*.	*d*.	*e*.
Tail to end of longest sessile arms	11·15	11·85	11·20	10·35	10·65	11·30	11·70	11·25	11·40	9·90	9·45	9·05	8·65	8·10	7·55	7·00
Tail to mantle edge, above	8·20	8·10	7·90	7·80	7·80	7·60	8·20	7·50	7·50	6·50	6·20	5·80	5·70	5·30	4·90	4·15
Tail to mantle edge, below	7·65	7·60	--	6·90	7·30	6·80	7·10	7·10	6·70	5·90	5·40	5·05	5·30	4·75	4·50	3·80
Tail to insertion of fin	4·95	4·90	5·00	4·80	4·80	4·60	5·00	4·55	4·40	3·75	3·50	3·40	3·20	3·00	2·60	2·20
Tail to eye	8·00	8·40	7·90	7·70	8·00	7·50	8·15	7·50	7·60	6·30	6·11	6·40	5·70	5·15	4·90	4·80
Tail to base of dorsal arms	8·30	7·90	8·40	8·40	8·40	8·90	8·70	8·25	8·10	7·00	6·55	6·75	6·40	5·75	5·25	4·95
Eye to end of dorsal arms	2·80	2·90	2·75	2·30	2·20	3·20	3·05	3·50	3·50	2·90	2·60	2·30	2·40	2·45	2·05	1·95
Eye to end of 2d pair arms	2·90	3·30	3·00	2·50	2·55	3·50	3·40	3·60	3·55	3·10	3·00	2·60	2·70	2·60	2·35	2·10
Eye to end of 3d pair arms	3·15	3·45	3·30	2·65	2·65	3·80	3·55	3·75	3·80	3·60	3·30	2·65	2·95	2·90	2·65	2·20
Eye to end of ventral arms	3·20	3·45	3·10	2·55	2·60	3·45	3·45	3·75	3·80	3·25	3·20	2·60	2·60	2·90	2·35	2·20
Eye to end of tentacular arms	6·10	6·30	6·00	3·60	4·20	7·00	6·20	5·65	6·30	6·80	5·30	5·10	6·80	5·45	4·60	4·60
Breadth of head, across eyes	1·30	1·00	1·20	1·10	1·15	1·40	1·25	1·20	1·20	1·25	1·10	·75	1·10	1·00	1·10	1·10
Breadth of head, in front of eyes	1·10	1·00	--	·90	1·00	1·35	1·20	1·05	1·25	1·10	·90	·75	·95	·95	·95	·95
Breadth of body	1·35	1·35	--	1·30	1·20	1·60	1·50	1·40	1·60	1·25	1·30	1·00	1·10	1·15	1·10	1·00
Breadth of fins	3·80	3·65	3·50	3·30	3·25	3·70	3·90	3·80	3·70	3·40	3·35	2·85	2·90	2·40	2·50	2·30
Circumference of body	4·20	3·80	3·15	3·60	3·40	4·65	4·60	4·05	4·30	3·80	4·15	3·40	3·45	3·35	3·20	2·90
Length of tentacular club	1·80	2·00	1·75	1·25	1·50	2·50	1·95	2·10	2·40	2·20	1·95	1·50	1·70	1·80	1·50	1·25
Proportions:																
Length of fin to mantle, 1:	1·65	1·65	1·58	1·62	1·62	1·65	1·64	1·64	1·70	1·75	1·77	1·70	1·78	1·76	1·88	1·90
Breadth of fin to mantle, 1:	2·16	2·21	2·25	2·36	2·40	2·06	2·10	1·97	2·03	1·91	1·85	2·18	1·96	2·20	1·96	1·80
Breadth of fin to its length, 1:	1·30	1·34	1·43	1·45	1·47	1·24	1·28	1·19	1·19	1.09	1·05	1·28	1·10	1·25	1·04	·96

Those marked D–W were taken in Vineyard Sound, May and June, 1876, and were preserved in too strong alcohol, some of them (as T–W) being very much contracted; X, Y, Z, were captured June 6, at the same place, and are in fair condition, though too much hardened by the alcohol. Those marked *a–e* were taken October 14, 1875, in the pounds at Wood's Holl, Vineyard Sound, and are well preserved; *h* and *k* are from Savin Rock, near New Haven; *oo* is from Noank, Conn.

E.—*Table illustrating variations of the female, due mostly to age and mode of preservation.* (*Measurements in inches.*)

Loligo Pealei ♀. Typical variety.	1V.	AA.	12V.	BB.	2V.	11V.	CC.	DD.	EE.	FF.	♀ U.	GG.	HH.
Tail to mantle-edge, above	9·40	9·10	8·62	8·60	8·30	8·25	7·70	7·95	7·20	7·65	7·40	5·95	6·10
Tail to mantle-edge, below	8·50	7·70	--	7·70	7·60	--	7·00	7·20	6·65	6·80	5·20	5·30	5·50
Tail to origin of fin	6·20	5·20	5·50	5·30	5·10	4·75	4·70	4·70	4·40	4·20	4·80	3·60	3·65
Tail to center of eye	9·60	9·75	9·00	8·20	8·70	9·15	7·80	8·10	7 60	8·00	3·00	6·00	6·05
Tail to base of dorsal arms	10·50	10·10	9 75	9·40	9·50	9·75	8·20	9·05	8·80	8·30	5·20	6·70	6·50
Length of dorsal arms	--	--	2·82	--	--	3·15	--	2·10	--	2·35	5·70	1·53	1·76
Eye to tip of dorsal arms	4·00	3·05	--	3·60	4·15	--	2·60	2·95	3·10	2·80	1·90	2·20	2·20
Eye to tip 2d pair of arms	4·15	3·40	--	4·10	4·40	--	2·80	3·10	3·50	3·00	1·90	2·25	2·50
Eye to tip 3d pair of arms	4·90	3·55	--	4.15	5·20	4·85	3·20	3·40	3·60	3·20	2·20	2·40	2·80
Eye to tip 4th pair of arms	4·50	3·55	--	3·60	4·50	--	3·10	2·85	3·45	3·20	2·20	2·20	2·40
Eye to tip of tentacular arms	10·00	5·30	8·25	5·70	9·00	9·50	4·40	4·45	5·30	5·10	3·05	3·70	5·20
Length of club	2·15	2·00	2·30	2·35	2·10	2·55	1·65	1·60	1·75	1·90	1·00	1·30	1·55
Breadth of head at eyes	1·50	1·30	1·58	1·40	1·40	1·55	1·30	1·40	1·30	1·25	·90	1·10	1·05
Breadth of head in front of eyes	1·25	1·25	--	1·30	1·20	--	1·20	1·20	1·10	1·10	1·00	·95	·90
Circumference of head in front of eyes	--	--	3·80	--	--	3·55	--	3·55	--	3·50	2·55	2·90	3·00
Breadth of body	1·85	1·70	1·70	1·60	2·00	1·75	1·40	1·40	1·60	1·45	3·05	1·10	1·40
Breadth of caudal fins	4·60	5·15	4·50	4·70	4·80	4·60	4·10	4·10	4·00	3·60	·95	3·10	3·20
Breadth between insertions	--	--	1·37	--	--	1·30	--	--	--	--	--	--	--
Circumference of body	5·50	5.30	5·40	4·90	5·50	5·15	4·30	4·40	4·80	4·30	--	3·45	3·90
Diameter of large tentacular suckers	·20	·19	·19	·26	·21	·19	·15	--	·18	·18	--	·11	·15
Diameter of largest of 3d pair of arms	·13	·12	·13	·14	·16	·12	·10	--	·10	·12	--	·08	·10
Proportions:													
Fin-length to mantle 1:	1·51	1·75	1·56	1·62	1·62	1·73	1·63	1·69	1·63	1·82	1·73	1·65	1·67
Fin-breadth to mantle-length 1:	2·04	1·82	1·91	1·82	1·72	1·79	1·87	1·95	1·80	2·12	2·03	1·90	1·90
Breadth to length of fin 1:	1·34	1·00	1·22	1·12	1·06	1·03	1·14	1·14	1·10	1·16	1·17	1·16	1·14
Circumference to mantle-length 1:	1·70	1·71	1·59	1·75	1·50	1·60	1·79	1·80	1·50	1·77	--	1·72	1·56
Length of dorsal arms to mantle-length 1:	--	--	3·05	--	--	2·62	--	3·78	--	3·25	--	3·23	3·46
Tentacular suckers to mantle-length 1:	47·00	49·47	45·36	33·07	39·50	43·42	51·33	-	40·00	42·50	--	54·09	40·66

AA to HH were taken in the fish-pounds at Wood's Holl, Vineyard Sound, in June, 1876, and have been preserved in somewhat too strong alcohol. 1V to 12V were taken at the same place, May 28, 1880, and have been carefully preserved in alcohol of about 80 per cent.

F.—*Table illustrating variations of males of* var. pallida, *due to growth, to the states of contraction when preserved, and to individual peculiarities.* (*Measurements in inches.*)

Loligo Pealei, var. pallida ♂.	l	B	b	Z	A	c	G	E	i	d	e	h	k
Tail to edge of mantle, above	9·15	9·3	9·	8·7	8·5	8·2	8·	8·	7·95	7·65	7·7	7·9	7·55
Tail to edge of mantle, beneath	8·5	8·65	8·25	8·1	7·7	7·6	7·3	7·2	7·35	7·	7·	7·2	6·8
Tail to origin of fin	5·8	5·8	5·4	5·25	5·2	5·	5·05	4·9	5·	4·75	4·65	4·7	4·5
Tail to center of eye	9·85	9·6	9·3	9·2	8·8	8·7	8·7	8·4	8·3	8·	7·8	8·05	7·8
Tail to base of dorsal arms	10·7	10·6	10·25	9·75	9·5	9·6	9·5	9·1	9·35	8·65	8·7	8·8	8·7
Eye to end of dorsal arms	4·15	4·45	4·1	3·8	4·2	4·1	4·0	3·8	4·05	3·55	4·	3·5	3·4
Eye to end of 2d pair arms	4·7	5·2	4·4	4·3	4·4	4·45	4·2	4·	4·35	4·	4·1	3·9	3·75
Eye to end of 3d pair arms	5·2	5·2	4·7	4·55	4·8	5·2	4·5	4·3	4·8	4·3	4·55	4·45	4·15
Eye to end of 4th pair arms	5·	4·7	4·45	4·05	4·5	4·8	4·35	4·1	4·45	4·	4·3	4·05	3·8
Eye to end of tentacular arms	10·8	10·3	9·3	9·9	10·15	9·1	9·5	8·9	9·9	9·	9·3	8·75	6·7
Length of club of tentacular arms	2·8	2·9	2·6	2·5	2·8	2·75	2·6	2·15	2·5	2·65	2·7	2·6	2·6
Breadth of head across eyes	1·5	1·6	--	1·35	1·6	1·45	1·3+	1·2+	1·2	--	1·4	1·45	1·2
Breadth of head in front of eyes	1·2	1·4	1·2	1·15	1·4	1·3	1·2	1·	1·15	--	1·15	1·25	1·05
Breadth of body	1·80	2·00	--	1·70	1·6	--	2·10	1·60	--	--	--	1·65	--
Breadth of caudal fins	5·00	5·15	4·5	4·60	5·00	4·6	4·50	4·50	4·5	3·9	4·1	4·40	3·75
Circumference of body	5·5	5·75	5·	4·9	5·15	5·25	5·25	4·7	5·1	5·	5·05	5·2	4·6
Diam. of largest suckers of club	·22	·24	--	·20	·21	--	·23	·18	--	--	--	·21	--
Diam. of largest suckers of 3d pair arms	·14	·13	--	·11	·13	--	·12	·12	--	--	--	·13	--
Proportions:													
Length of fin to length of mantle ..... 1 :	1·57	1·60	1·66	1·65	1·66	1·64	1·58	1·63	1·59	1·61	1·65	1·68	1·67
Breadth of fin to length of mantle ..... 1 :	1·83	1·80	2·00	1·88	1·70	1·78	1·77	1·77	1·76	1·96	1·87	1·79	2·01
Breadth of fin to its length ..... 1 :	1·16	1·12	1·20	1·14	1·00	1·08	1·12	1·08	1·11	1·21	1·13	1·06	1·20
Large tentacular sucker to mantle ..... 1 :	41·59	38·75	--	43·50	40·47	--	34·78	44·44	--	--	--	37·62	--
Circumference of body to mantle ..... 1 :	1·66	1·61	1·80	1·77	1·65	1·56	1·52	1·70	1·55	1·53	1·52	1·51	1·64

All the specimens included in this table were taken nearly at the same time in the autumn of 1870, at Astoria, Long Island. The measurements are all from the specimens after they had been preserved in alcohol (of about 80 per cent.) for several years. They are only moderately contracted by the alcohol. They were sent to New Haven, in ice, before preservation, so that they were in a relaxed condition when put into alcohol.

Table F.—*Continued. Table illustrating variations of males of* var. pallida.

Loligo Pealei, var. pallida ♂.	J	f	V	W	l	a	K	L	M	Q	S	P
Tail to edge of mantle, above	7·3	7·1	6·6	7·	7·10	4·3	4·	4·	3·8	3·7	3·7	3·65
Tail to edge of mantle, beneath	6·7	6·5	6·1	6·2	6·30	3·8	3·4	3·4	3·2	3·2	3·3	3·2
Tail to origin of fin	4·4	4·	3·9	4·2	4·30	2·3	2·1	2·	2·	2·	1·8	2·
Tail to center of eye	7·7	7·55	7·	7·4	7·5	4·75	4·5	4·2	4·05	4·2	3·9	3·9
Tail to base of dorsal arms	9·15	8·3	7·3	8·15	1·8	5·2	5·	4·7	4·5	4·6	4·3	4·4
Eye to end of dorsal arms	3·7	3·7	3·1	3·5	3·7	2·3	2·	2·15	2·	2·1	1·8	1·8
Eye to end of 2d pair arms	4·	3·8	3·7	3·6	4·15	2·5	2·3	2·5	2·2	2·4	1·9	2·1
Eye to end of 3d pair arms	4·45	4·1	4·1	4·2	4·55	3·	2·55	2·7	2·5	2·7	2·3	2·6
Eye to end of 4th pair arms	4·3	3·8	3·6	4·	4.	2·7	2·2	2·65	2·45	2·4	2·3	2·2
Eye to end of tentacular arms	--	9·3	7·7	8·6	9·25	6·45	4·8	5·9	5·9	6·1	5·5	5·25
Length of club of tentacular arms	--	2·3	2·	2·4	2·60	1·5	1·3	1·45	1·3	1·2	1·2	1·
Breadth of head across eyes	1·1 +	1·25	1·2	1·2	1·20	·9	·9	·9	·8	·8	·8	·8
Breadth of head in front of eyes	1·1	1·1	1·1	1·	·95	·75	·8	·75	·7	·7	·65	·7
Breadth of body	--	--	--	--	1·65	--	--	--	--	--	--	--
Breadth of caudal fins	4·1	3·95	3·3	4·	3·90	2·4	2·1	2·5	2·	2·	2·1	1·9
Circumference of body	4·7	4·45	4·6	4·75	4·80	3·6	3·3	3·6	3·1	3·25	3·35	3·25
Diam. of largest suckers of club	--	--	--	--	·21	--	--	--	--	--	--	--
Diam. of largest suckers of 3d pair arms	--	--	--	--	·13	--	--	--	--	--	--	--
Proportions:												
Length of fin to length of mantle ——1:	1·65	1·77	1·69	1·66	1·69	1·86	1·90	2·00	1·90	1·85	2·05	1·85
Breadth of fin to length of mantle——1:	1·77	1·79	2·00	1·75	1·89	1·79	1·90	1·60	1·90	1·85	1·76	1·92
Breadth of fin to its length ——1:	1·07	1·01	1·18	1·05	1·12	·95	1·00	·80	1·00	1·10	0·85	1·05
Largest tentacular sucker to mantle ——1:	--	--	--	--	33·80	--	--	--	--	--	--	--
Circumference of body to mantle——1:	1·55	1·59	1·43	1·47	1·47	1·19	1·21	1·11	1·22	1·13	1·10	1·12

G.—*Table illustrating variations of females of* var. pallida, *due to growth, etc.* (*Measurements in inches.*)

Loligo Pealei, var. pallida ♀.	j	Y	l	X	D	g	m	C	T	U	H	n	F	? sex O	R	N
Tail to edge of mantle, above	8·4	8·15	7·	6·7	6·35	6·25	6·2	5·10	4·65	4·60	4·25	3·9	3·85	3·6	3·6	3·62
Tail to edge of mantle, beneath	7·65	7·35	6·3	6·	5·8	5·75	5·7	4·35	3·9	4·	3·7	3·4	3·35	3·2	3·2	3·1
Tail to origin of fin	5·15	4·8	4·3	4·2	3·9	3·7	3·60	2·8	2·55	2·5	2·30	2·	2·	2·	2·	1·95
Tail to center of eye	8·8	8·5	7·35	7·1	6·5	6·7	6·5	5·25	4·8	4·7	4·3	4·2	4·15	4·	4·	4·
Tail to base of dorsal arms	9·5	9·15	8·2	8·	7·3	7·4	7·15	6·	5·2	5·25	5·	4·45	4·6	4·5	4·3	4·3
Eye to end of dorsal arms	4·15	3·8	3·6	3·3	3·3	3·	3·	2·1	2·05	2·4	2·	1·3	1·9	1·6	1·8	1·8
Eye to end of 2d pair arms	4·5	4·4	4·	3·95	3·8	3·3	3·2	2·5	2·4	2·7	2·2	2·	2·2	2·2	1·9	1·9
Eye to end of 3d pair arms	5·	4·6	4·6	4·3	3·95	3·7	3·7	3·05	2·55	3·15	2·55	2·55	2·65	2·45	2·4	2·25
Eye to end of 4th pair arms	4·5	4·35	4·35	4·25	3·8	3·6	3·7	3·05	2·55	3·15	2·7	2·25	2·55	2·2	2·4	2·25
Eye to end of tentacular arms	10·1	9·3	9·8	9·1	8·9	7·8	8·3	7·1	5·5	6·5	5·45	5·15	5·9	5·2	5·3	5·1
Length of club to tentacular arms	2·9	2·45	2·7	2·6	2·2	2·	2·1	1·6	1·1	1·4	1·2	1·3	1·35	1·1	1·8	1·15
Total length, tail to end of tentacles	19·	17·8	17·1	16·2	--	14·45	15·	12·00	·9	11·2	--	9·2	--	9·25	9·25	9·15
Breadth of head across eyes	1·45	1·4	1·3	1·3	1·4	1·1	1·15	1·00	·8	1·	·9	·95	·9	·8	·9	·85
Breadth in front of eyes	1·3	1·3	1·2	1·2	1·1	·9	1·	·85	--	·85	·75	·8	·6	·7	·75	·70
Breadth of body	1·90	1·85	--	--	1·55	--	--	1·40	2·70	--	1·35	--	1·20	--	--	--
Breadth of caudal fins	4·8	4·40	4·1	4·6	4·1	3·5	3·60	3·10	3·75	2·8	2·65	2·45	2·25	2·1	2·25	2·05
Circumference of body	5·5	5·5	4·8	4·9	4·6	4·4	4·4	4·2	--	4·	--	3·5	3·5	3·2	3·25	3·05
Diam. of largest suckers of club	·25	·20	--	·22	·17	·18	·16	·15	--	·12	--	--	·08	--	--	--
Diam. of largest suckers of 3d pair arms	·12	·13	--	·12	·10	·11	·11	·8	--	·08	--	--	·05	--	--	--
Proportions:																
Length of fin to length of mantle 1 :	1·63	1·69	1·62	1·59	1·62	1·68	1·72	1·82	1·82	1·84	1·84	1·95	1·92	1·80	1·80	1·85
Breadth of fin to length of mantle 1 :	1·75	1·85	1·70	1·45	1·54	1·78	1·72	1·65	1·72	1·64	1·60	1·59	1·71	1·71	1·60	1·76
Breadth of fin to its length 1 :	1·07	1·09	1·04	·91	·95	1·05	1·00	·90	·94	·89	·86	·81	·88	·95	·88	·95
Largest tentacular sucker to mantle 1 :	33·60	40·75	--	30·45	37·35	34·72	38·75	34·00	--	38·33	--	--	48·12	--	--	--
Circumference of body to mantle 1 :	1·52	1·48	1·45	1·36	1·38	1·42	1·40	1·21	1·24	1·15	--	1·11	1·10	1·12	1·10	1·18

The specimens included in this table were all taken at Astoria, Long Island. The measurements are all from alcoholic specimens, as in Table F.

I.—*Table to illustrate rate of growth of* Loligo Pealei, *young.*

Locality.	Depth.	Date.	Length of mantle, in millimeters.	
			Young of the year.	Young of previous year.
		1875–76.		
Vineyard Sound	Surface	July 7	36=25–35^{mm} : 3=45–48^{mm}	10=75–100^{mm}
Vineyard Sound	Surface	July 12	100+=10–20	
Vineyard Sound	Surface	July 15	4=50–68	9=70–100
Vineyard Sound	Surface	July 16	500+=10–25	----------
Vineyard Sound	Surface	July 28	500+=10–30	----------
Vineyard Sound	Surface	Aug. 2	200+=15–35	----------
Vineyard Sound	--	Aug. 21	26=27–52	----------
Vineyard Sound	--	Aug. 27	18=23–50	----------
Vineyard Sound	--	Aug. 28	38=25–50 : 2=55–63	----------
Vineyard Sound	--	Aug.	30=25–45 : 10=47–72	2 ♀ =125–150 : 1 ♂ =175
Vineyard Sound	6–20	Sept. 15	3=45–50	2=125–138
Vineyard Sound	--	Oct. 13	----------	1=188
Vineyard Sound	--	Oct. 20	4=88–100	4=112–125
Vineyard Sound	Surface	Nov. 1	1000=8–20 : 3=75–82	1=152
Vineyard Sound	Surface	May 15	----------	3=152–188
Vineyard Sound	Surface	June 3	----------	80=62–100 : 10=100–152
		1880.		
Newport, R. I.	Shore	July 27	4=28 : 5=32–44	5=67–80 : 1=95
Narragansett Bay	8	Aug. 6	5=45–50	3=84–100
Off Newport, R. I.	16–26	Aug. 7	54=15–33 : 49=32–44 : 5=50–62	3=89–108 : 2=120–165
Off Newport, R. I.	16–19	Aug. 12	90=15–25 : 15=30–40	----- ----

TABLE I.—*Continued. Table to illustrate rate of growth of* Loligo Pealei, *young.*

Locality.	Depth.	Date.	Length of mantle, in millimeters.	
			Young of the year.	Young of previous year.
		1880.		
Off Point Judith, R. I.	16	Aug. 13	60=17–38 : 20=38–55	1=115 : 1=102
Off Point Judith, R. I.	19	Aug. 14	133=16–33 : 8=38–44	2=86–87 : 2 ♀ =105–112
Narragansett Bay	4–12	Aug. 16	33=23–55 : 14=50–70 : 3=75–82	3=83–95
Off Buzzard's Bay	21	Aug. 17	72=12–28 : 5=30–42	----------
Narragansett Bay	6	Aug. 23	2=48–53 : 3=70–80	----------
Off Block Island	13	Aug. 24	9=24–36 : 8=40–55	----------
Off Block Island	5	Aug. 27	1 ♂ =84	1 ♀ =110
Narragansett Bay	14	Aug. 31	7=38–46 : 2=60–62	----------
Narragansett Bay	3–6	Sept. 1	2=32–46 : 11=50–52	----------
Off Cuttyhunk Island	17	Sept. 3	23=32–50 : 4=56–58 : 1=82	2=130–140
N. lat. 39° 48′ 30″. W. long. 70° 54′.	252	Sept. 13	14=16–30	----------
Off Block Island	--	Sept.	20=42–55 : 10=55–72 : 1=110	----------
Off Chesapeake Bay	18	Nov. 16	32	----------
Var. borealis:		1878.		
Massachusetts Bay	10	Aug. 29	1=31	----------
Massachusetts Bay	42	Sept. 16	1=38	----------
Massachusetts Bay	47	Sept. 21	6=28–38 : 1=50 : 5=62	----------
Massachusetts Bay	43	Sept. 26	2=31–38	----------
		1879.	----------	----------
Off Cape Cod	15½	Sept. 9	2=38	----------
Off Cape Cod	42	Sept. 26	1=75	----------
Cape Ann	Shore	Oct., '80	5 ♂ 3 ♀ =110–156	----------

J.—Specimens examined, mostly adult. To illustrate distribution, etc.

[In last column *ad.* = adult; *br.* = breeding; *in.* = length of mantle in inches; *j.* or *juv.* = young; *lg.* = large.]

No.	Locality.	Fath.	When Collected.	Received from	Specimens. Sex. No.
	Typical variety.				
--	New Haven, Conn.	--	1867	Mr. Hooes	1 ♂
--	New Haven, Conn.	--	----	G. H. Perkins	1 ♂
--	Near New Haven	Shore	1870	A. E. Verrill	4 ad.
h. k.	Near New Haven	Shore	1874	A. E. Verrill	♂ 4 ad.
c′	Near New Haven	Shore	1876	A. E. Verrill	6 ad.
1G	New Haven harbor	Shore	May 18, 1880	A. E. Verrill	♂ 1 lg. br.
--	Long Island	Shore	----	C. C. Byrne	1 juv.
a′, b′, oo	Noank, Conn.	Shore	August, 1874	U. S. Fish Com.	♂ 3 large
--	Noank, Conn.	3–4	August 5, 1874	U. S. Fish Com.	4 young
--	Noank, Conn.	6–8	August 24, 1874	U. S. Fish Com.	8 juv.
--	Vineyard Sound, Ms.	Shore	Jl. and Aug., '71	U. S. Fish Com.	?2 ad.
--	Vineyard Sound, Ms.	5–8	Jl. and Aug., '71	U. S. Fish Com.	30 ad.
--	Menemsha	Shore	August, 1874	V. N. Edwards	♂ 1. ♀ 2
--	Vineyard Sound	Shore	Jl. and Aug., '75	U. S. Fish Com.	7 ad.
--	Vineyard Sound	5–12	July 12–26, 1875	U. S. Fish Com.	Eggs & y'ng
--	Vineyard Sound	5–16	Aug. 4, 5, 1875	U. S. Fish Com.	Young
--	Vineyard Sound	6–20	Sept. 15, 1875	U. S. Fish Com.	5 young
--	Vineyard Sound	Shore	October 13, 1875	V. N. Edwards	3=5–7·5 in.
f, g.	Vineyard Sound	Shore	October 14, 1875	V. N. Edwards	3=5–7 in.
a–e	Vineyard Sound	Shore	October 14, 1875	V. N. Edwards	♂ 5 large
--	Vineyard Sound	Shore	October 20, 1875	V. N. Edwards	5=4–5 in.
--	Vineyard Sound	Shore	Nov. 1, 1875	V. N. Edwards	1=6 in.
--	Vineyard Sound	Shore	April 30, 1876	V. N. Edwards	♂ 10 : ♀ 3
--	Vineyard Sound	Shore	May 15, 1876	V. N. Edwards	3=6–7 in.
D–W	Vineyard Sound	Shore	May and June, '76	V. N. Edwards	♂ 15 : ♀ 4 ad.
--	Vineyard Sound	Shore	June 3, 1876	V. N. Edwards	♂ 3=5–6 in.
X. Y. Z.	Vineyard Sound	Shore	June 6, 1876	V. N. Edwards	♂ 3 large
AA–HH	Vineyard Sound	Shore	June, 1876	V. N. Edwards	39 ad. : ♀ 12
IV–60V	Vineyard Sound	Shore	May 28, 1880	V. N. Edwards	♂ 48: ♀ 12br.
--	Narragansett Bay	Shore	1880	Samuel Powell	10 ad.
A1	Hyannis, Mass.	Shore	August, 1880	----	♂ 1 very lg.
--	Narragansett Bay	Shore	July 27, 1880	U. S. Fish Com.	6 j.=3–3·7 in.
--	Off Newport, R. I.	16–26	August 7, 1880	U. S. Fish Com.	5j.=3·5–6·5in.
--	Off Pt. Judith, R. I.	19	August 14, 1880	U. S. Fish Com.	2j.=1·1-1·4in
--	Off Cuttyhunk Island	17	Sept. 3, 1880	U. S. Fish Com.	2=5·1-5·5in.
--	South of Block Island	252 (?)	Sept. 13, 1880	U. S. Fish Com.	14 juv.
--	Off Chesapeake Bay	18	Nov. 16, 1880	Z. L. Tanner	32 juv.
	Variety borealis.				
An.1–3.*g*	Annisquam, Mass.	Shore	July, 1878	A. Hyatt	♀ 3 ad. br.
--	Glouce'r, M., tide-pool	Shore	July, 1878	A. E. Verrill	2 juv.
--	Massachusetts Bay	47	Sept. 21, 1878	U. S. Fish Com.	11 juv.
--	Off Cape Cod	42	Sept. 26, 1879	U. S. Fish Com.	1 juv.
--	Provincetown, Mass.	Shore	July, 1879	J. H. Blake	3 large
2G–15G	Cape Ann, Mass.	Shore	May 18, 1880	A. H. Clarke	15 ad. br.
--	Cape Ann, Mass.	Shore	October, 1880	A. H. Clarke	♂ 5 : ♀ 3 juv.
--	Salem, Mass.	Shore	----	J. H. Emerton	♂ 1 : ♀ 2 ad.
	Variety pallida.				
A–Z	Astoria, N. Y.	Shore	Nov.–Dec., 1870	Robt. Benner	♂ 17 : ♀ 9
a–t	Astoria, N. Y.	Shore	Nov.–Dec., 1870	Robt. Benner	♂ ♀ 20 ad.
1–10	Astoria, N. Y.	Shore	Nov.–Dec., 1870	Robt. Benner	♂ ♀ ad.
--	Gr't Egg Harbor, N.J.	Shore	1872	A. E. Verrill	1, bass stom.

K.—*Specimens examined. Eggs and recently hatched young of* Loligo Pealei.

Locality.	Fath.	When collected.	Received from	Eggs or Embryos.
Near New Haven	Shore	June 19, 1871	J. E. Todd	Well developed.
Vineyard Sound	5–10	July, Aug. '71	U. S. Fish Com.	All stages.
Long Island Sound	4–8	August, 1874	U. S. Fish Com.	Well developed.
Fisher's Sound	Surf'ce	July 28, 1874	U. S. Fish Com.	Just hatched.
Nantucket Sound	8–12	July 26, 1874	U. S. Fish Com.	Partly developed.
Vineyard Sound	8–16	Aug. 5, 1875	U. S. Fish Com.	Partly developed.
Vineyard Sound	5–10	July, Aug. '75	U. S. Fish Com.	All stages.
Vineyard Sound		Sept. 6, 1875	U. S. Fish Com.	New-laid.
Near New Haven	Shore	June 11, 1880	S. I. Smith	Near hatching.
Off New Haven		Aug. 3, 1880	J. F. Fowle	Half developed.
Gardiner's Bay		June 28, 1880	Sch. G. H. Bradley	New-laid.
Off Newport, R. I.	8	Aug. 6, 1880	U. S. Fish Com.	Fresh and well developed.
Off Newport, R. I.	22–26	Aug. 7, 1880	U. S. Fish Com.	New-laid and hatching.
Off Newport, R. I.	4½	Aug. 16, 1880	U. S. Fish Com.	New-laid and partly dev.
Narragansett Bay	6	Aug. 23, 1880	U. S. Fish Com.	Fresh-laid.
Narragansett Bay	12½	Aug. 31, 1880	U. S. Fish Com.	Partly developed.

In the Gulf of Mexico, this species appears to be replaced by another species (*Loligo Gahi* D'Orbigny). Of this we have several specimens, collected on the west coast of Florida, at Egmont Key, near Tampa Bay, by Col. E. Jewett and Mr. W. T. Coons. This species is closely allied to *L. Pealei*, but has a more slender form, with the caudal fin shorter and narrower in proportion to the length of the mantle. The pen has a shorter and broader shaft and a narrower and more oblong blade, which has parallel, thickened and darker colored portions between the midrib and margins. The tentacular suckers have their horny rings more coarsely and equally toothed, there being only a partial alternation of larger and smaller teeth.

Along our southern coast, from Delaware Bay to Florida, a much shorter and relatively stouter species (*Loligo brevis* Bv.) occurs, which might be mistaken, by a careless observer, for the present species. In addition to its shorter body, it has very different large tentacular suckers, with the teeth on the horny rim coarser and all of similar form and size. Its pen is also shorter and relatively broader, and different in structure.

Notes on the Visceral Anatomy.

PLATE XL, FIGURES 1-3*a*. PLATE XLI, FIGURE 1, ♀.

The gills (*g*) are large and highly organized in this species, although considerably smaller than in *Ommastrephes*. The bases of the gills are situated somewhat in advance of the middle of the mantle-cavity, and their tips, in fresh specimens, extend forward nearly to the base of the siphon (*f*). The branchial chamber, behind the heart,

is divided into two chambers by a median, thin, membranous partition.

The branchial chamber is separated from the visceral cavity by a thin, translucent membrane, through which there are two circular openings (*u*), one a short distance in advance of the base of each gill; through these the secretions of the urinary organs (*r*, *r'*) are doubtless discharged. Internally the visceral cavity is divided into several compartments by folds of thin membrane. The largest of these chambers contains the stomach and its cœcal lobe (*S*, *S'*). When the branchial cavity is opened on the ventral side, as in Pl. XL, fig. 1, and the thin membranes covering the viscera are removed, the renal organs (*r*, *r'*) are seen, as large and conspicuous organs, especially if the venous system has been injected with a colored fluid. These organs are situated below, above, and in front of the heart, but two pyriform glands (*r'*, *r'*), which are firmer and have a more compact structure than the rest, extend along the posterior venæ-cavæ. The anterior ones, in front of the heart, consist of a number of groups or clusters of lobulated glandular follicles, developed upon the posterior part of the anterior vena-cava and upon its saccular divisions, on the hepatic veins, on the intestinal veins, and on other large veins going toward the branchial auricles (*au*). Two of the larger divisions (*r*, *r*), which are elongated, and lie below and across the heart and large efferent vessels (*bo*) returning from the gills, arise as direct forks of the vena-cava, which divides just in front of the origin of the intestine; these forks pass each side of the intestine and each gives off a dorsal branch, which runs up along the basal part of the intestine and joins the large saccular renal vessels that lie above the heart, on each side. These dorsal, renal vessels extend backward beyond the heart; they receive the blood from the gastric veins posteriorly and from two hepatic veins anteriorly; laterally, they communicate directly with the branchial auricles.

The ventricular heart (*H*) is a rather large, muscular, median, somewhat unsymmetrical organ, varying in shape according to the state of contraction. Usually it is more or less obliquely four-cornered, with the right side largest and the posterior end more or less conical. From the posterior end arises a large artery, the posterior aorta, which gives off, close to its origin, two small arteries; one of these is median, and goes forward to the ink-sac, passing below the heart; two branches, close to its origin, go to the renal organs (*r*, *r*), on each side; the other, arising laterally, goes to the prostate gland and other organs connected with it, (Pl. XL, fig. 2, *po*). A little farther back

the posterior aorta divides into three large arteries: one of these (*o*) is situated in the median plane, and crossing the branchial cavity in a curved line along the edge of the thin median membrane, supplies the ventral and lateral portions of the mantle, sending branches both forward and backward; the other two main branches (*o' o''*) diverge as they go backward and supply the caudal fins and adjacent parts of the mantle. The anterior aorta (*ao*) arises from the right anterior corner of the heart, and goes forward to the head, on the right side of the median line, by the side of the œsophagus, giving off from its sides various small branches. Near its origin it is somewhat bulbous.

The first branch, the gastric artery, arising not far from its origin, sends a branch to the renal organs, and running backward over the dorsal side of the heart, ramifies over both lobes of the stomach. During its passage through the substance of the liver, and along the groove on its dorsal side, the aorta gives off several branches which supply that organ with blood, while one artery, of considerable size, emerges from the posterio-dorsal side of the liver and supplies the muscles of the neck; others go out from the anterior part of the liver, laterally and ventrally, to various parts of the head. Ten large branches go to the arms, one running through the center of each to the tip, sending off numerous lateral branches to the suckers and other parts. Other branches supply the various organs of the head. A small artery (fig. 2, *go*) arises from the anterior side of the heart, and turning backward, supplies the spermary (*t*). The large efferent vessels (*branchio-cardiac*) from the gills (*bo*) enter the anterio-lateral corners of the heart, their dilated basal portions serving as auricles.

The branchial auricles (*au*), situated just behind the bases of the gills, are nearly globular, with a small, rounded, whitish elevation on the free posterior end; dorsally they receive the blood from the saccular divisions of the anterior and posterior venæ-cavæ (*vc, vc'*) and from the veins (*v, vc'*) coming from the lateral portions of the mantle, behind the gills; and they give off the large afferent vessels (*bv*) which go to and run along the dorsal side of the gills.

The anterior vena-cava (*vc*) receives the venous blood from a large cephalic venous sinus, which surrounds the pharynx, at the bases of the arms,* and is connected with another large sinus situated at the

* The greater part of the venous system can be easily injected by inserting a canula into this sinus, through the fold of the buccal membranes between the bases of the arms and the jaws, or between the outer and inner buccal membranes. It can also be easily injected through the vena-cava in the lower side of the head.

back of each eye-orbit. This cephalic sinus receives the blood from a large vein in the median line and near the inner surface of each arm. Numerous small veins from the head and eyes also enter this and the ophthalmic sinuses; others, entering the anterior vena-cava, from each side, along its course, come from the muscles of the head, neck and siphon, from the ink-sac, anterior part of the liver, etc. Two veins of considerable size, which become sacculated posteriorly, arise from the intestine and ink-sac and run back to the sacculated divisions of the vena-cava. A small vein also extends along the dorsal side of the efferent sperm-duct (*p*). Two large pallial veins, uniting together close to the branchial auricles, on each side, come from the sides of the mantle (*v*, *vc'*); one of these (*vc'*) runs from the anterior part backward, and receives a branch (fig. 1) from the gill; the other (*v*), from the middle and posterior parts forward. The posterior venæ-cavæ (*vc''*) arise mostly in the caudal fins and posterio lateral portions of the mantle; each one receives two large branches, one anterior and the other posterior, just at the point where it leaves the inner surface of the mantle. From this point they run forward parallel with the two posterior arteries, and converge to the region of the heart, where they join the great sacculated venous vessels (*r*); along a considerable portion of their course they expand and become large, elongated, fusiform organs (*r'*), probably renal in function, but much firmer, more definite in form, and finer in structure than the more anterior renal organs.

The gills (*g*) are long, triquetral, acute, in section they are nearly triangular, with the free ventral sides convex, and the dorsal side flat or concave, except along the middle, where a thin median membrane (*g*) arises from the central stem and unites the gill to the inner surface of the mantle. The gills are composed of large numbers of thin, transverse branchial laminæ, which extend outward symmetrically on each side from the large median blood vessels (*bo*, *bv*), each lamina having a long-ovate or crescent-shaped outline. A somewhat firm central axis or column gives support to the laminæ and the large blood vessels. The great afferent vessel (fig. 1, *bv*) starts from the branchial auricle (*au*) and runs along the median-dorsal side of the gill, on the inner edge of the axial column; a parallel vein (fig. 1), near the dorsal edge of the column, runs back and joins the lateral pallial vein (*vc'*). Each branchial leaf receives from the afferent vessel (*bv*), a branch which runs along the dorsal edge, giving off at regular intervals small, transverse, parallel branchlets, which in turn give off minute capillary vessels along their sides, and fade out near

the ventral border of the laminæ. Parallel with these arise small, capillary, efferent vessels, which join larger transverse vessels, between and parallel with the afferent ones; these in turn join the larger efferent vessel that runs along the ventral edges of the laminæ, and these marginal vessels pour their contents into the large branchio-cardiac vessel (*bo*) which runs along the middle of the gill, on the ventral side, and carries the purified blood to the heart.

The buccal membranes, the pharynx, with its horny jaws, the odontophore, armed with seven rows of recurved teeth on the radula, and the thin, chitinous, lining membrane, which has numerous sharp, scattered, recurved teeth, both on the palate and in the throat, have already been described (pp. 311, 312). The œsophagus is a long, narrow, but dilatable tube, having two oblong salivary glands attached to it, within the bilobed anterior end of the liver (*l*); it then runs backward in a groove along the dorsal side of the liver, to a point beyond its middle, where it passes obliquely through the liver, accompanied by the aorta (*ao*), and dorsally enters the stomach (*S*). The stomach consists of three parts, which are often sufficiently distinct externally, when the stomach is empty, or nearly so, but when it is greatly distended with food (as often happens), the apparent divisions almost disappear and the whole becomes one great, long-pyriform sac. The first division (*S*) or 'true stomach,' is plicated internally and has thickened glandular walls. It is supplied with blood by a conspicuously ramified vessel, the gastric artery (*so*). This lobe of the stomach is sometimes contracted into a firm glandular mass, strongly constricted where it joins the more saccular second stomach; but I have seen specimens greatly distended with food in which it was scarcely or not at all distinguishable as a lobe, and seemed as thin and saccular as the other parts. The remainder of the stomach (*S'*) usually has the form of a long, more or less swollen, ovate sac, tapering backward to a somewhat acute posterior end, which reaches back nearly to the end of the body; anteriorly its most swollen portion is about opposite the junction with the first stomach, and just behind the heart; from this swollen portion it narrows rapidly, but extends forward along the posterior part of the liver, above and in advance of the heart, where it gives off the intestine. The more swollen anterior portion (*k*), of this sac, the second stomach, has a glandular lining and is distinctly radially plicated, and is, therefore, clearly anatomically distinguishable from the thin and non-plicated posterior portion, or cœcal lobe, (*S'*) which seems to serve mainly for the temporary storage of large quantities of food.

The intestine (*h*) is a rather wide and thin tube, of moderate length; the anal orifice is provided with two slender, clavate papillæ. The ink-sac (*i*) is large, long-pyriform, with a long tapering duct (*i'*) terminating just within the anal orifice. The liver (*l*) is a long, rather narrow, somewhat fusiform organ, slightly bilobed anteriorly and pointed posteriorly; along about two thirds of its length, from the anterior end, there is a deep dorsal groove, in which the œsophagus and aorta are situated, before they pass through its substance; the posterior end is simple and pointed.

In the appearance and structure of the internal reproductive organs the sexes differ greatly. In the female (pl. XL, figs. 3, 3*a*; pl. XLI, fig. 1), the single large oviduct (*od*, *od'*), situated on the left side, passes over the dorsal side of the base of the gill and terminates in a large ear-shaped external orifice (*op*), nearly surrounded by a broad membranous flap. The portion of the oviduct behind the base of the gill is enveloped by a large, swollen, bilobed, nidamental gland (*x'*), which is abundantly supplied with blood-vessels, and internally is composed of a large number of thin, close, parallel lamellæ. Two very large, oblong, accessory nidamental glands (*xx*) lie, side by side, loosely attached, nearly in the middle of the ventral side, covering and concealing the heart and most of the renal organs; each of these has a groove along the ventral side and a slit in the anterior end; internally they are composed of great numbers of thin lamellæ. In front of, and partially above the anterior ends of these, and attached to the intestine and ink-sac, there is another pair of accessory glands (*x*), roundish in form, with a large ventral opening, and having, in fresh specimens, a curiously mottled color, consisting of irregular red and dark brown blotches, on a pale ground. Their internal structure is made up of fine follicles.

The ovary (*ov*) is large and occupies a large portion of the cavity of the body posteriorly, running back into the posterior cavity of the pen, and in the breeding season, extending forward nearly to the heart. In the breeding season, the thin convoluted portion of the oviduct (*ov'*) is found distended with great numbers of eggs. At the same time the large glands (*x'*), around the oviduct, and the accessory nidamental glands (*x*, *xx*), destined to furnish the materials for the formation of the egg-capsules, and for their attachment, are very turgid and much larger than at other times.

The male (Pl. XL, figs. 1, 2) has no organs corresponding in position to the two pairs of accessory nidamental glands of the female, but the single efferent spermatic duct or 'penis' (*p*) occupies the same

position, on the left side, as the terminal part of the oviduct of the female. It is, however, a much more slender tube, extending farther forward beyond the base of the gill, and its orifice is small and simply bilabiate. It extends backward, over the dorsal side of the base of the gill, to a bilobed, long-pyriform organ, consisting of a spermatophore-sac (*ss*) and a complicated system of glands and ducts (*pr*, *vd*), united closely together and enclosed in a special sheath; in these the spermatophores are formed. These organs consist of the following parts:

1. The vas-deferens (*vd*), which starts posteriorly from a small orifice (not figured) in the thin sheath of peritoneal membrane (*pt*) investing the testicle (*t*); it passes forward along the side of the spermatophore-sac, to which it is closely adherent, and throughout most of its length it is thrown into numerous close, short, transverse, flattened folds; anteriorly it joins the vesiculæ-seminales.

2. The vesiculæ-seminales (fig. 2, *pr*, in part) consist of three large curved vesicles, closely coiled together, and having thickened, glandular walls; the first two are short and broad, the third is elongated; from the latter goes a short duct, which unites with the duct from the prostate gland to form the spermatic duct.

3. The prostate gland (*pr*, in part) is broad-ovate and consists of two rounded lobes, one large and the other small, which are closely united to and enclosed between the vesiculæ-seminales.

4. The spermatic duct, formed by the union of the ducts from the vesiculæ-seminales and prostate glands, is a nearly straight tube; it passes backward between the prostate glands and spermatophore-sac, close alongside of the vas-deferens (*vd*), to which it is closely bound down; it enters the spermatophore-sac (*ss*) near its posterior end, at an acute angle. Even at its origin it contains spermatophores.

5. The spermatophore-sac (*ss*) is a long, capacious, pyriform or somewhat fusiform, thin-walled sac, pointed at its posterior end; its anterior end is directly continuous with the long efferent duct (*p*), which is often rather wide at its origin, but tapers to a narrow anterior end. The terminal orifice is slightly bilabiate.

These organs receive blood through a special artery (fig. 2, *po*) which arises from the posterior aorta just back of the heart. After reaching the genital organs it divides into several branches: one goes forward along the side of the efferent duct; one to the prostate glands and vesiculæ-seminales; one to the vas-deferens and adjacent parts.

Specimens taken in May, in the breeding season, have the efferent

duct and the spermatophore-sac crowded with the spermatophores. In the spermatophore-sac, which is then much distended by them, they lie closely packed in a longitudinal position, with their larger ends pointing somewhat outward toward the surface, and can be plainly seen through the transparent walls of the sac.

The spermatophores are slender, club-shaped, with the larger end rounded, tapering gradually to the smaller end, which is usually a little expanded at the tip and has a very small filament. They vary (in alcohol) from 8 to 10^{mm} in length and from ·4 to ·5^{mm} in the greatest diameter. They contain a coiled rope of spermatozoa in the larger end, and a complicated apparatus for automatically ejecting this rope, in the smaller portion.

The 'testicle,' or spermary (*t*), is a compact, pale yellow, long, flattened organ, extending from the stomach (*S*) nearly to the end of the pen, in the posterior concavity of which it lies; a band of fibrous tissue, continuous with its sheath, extends from its posterior end into the hollow tip of the pen, to which it is attached. An arterial vessel, the spermatic artery (Pl. XL, fig. 2, *go*), which arises directly from the anterior edge of the heart, runs along the median dorsal line of the spermary and sends off numerous branches to the right and left (fig. 2, *t*). This artery is accompanied by a spermatic vein which is closely united to it.

Loligo brevis Blainville.

Loligo brevis Blainv., Journ. de Phys., March, 1823 (t. D'Orb.); Dict. des. Sci. nat., vol. xxvii, p. 145, 1823.

D'Orbigny, Céphal. Acétab., p. 314. *Loligo*, pl. 13, figs. 4–6 (copied from Lesueur), pl. 15, figs. 1–3 (orig.); pl. 24, figs. 14–19 (orig.)

Tryon, Man. Conch., i, p. 142. pl. 52, figs. 143, 144 (after D'Orbigny.)

Loligo brevipinna Lesueur, Journ. Acad. Nat. Sci. Philad., vol. iii, p. 282, plate 10, figs. 1–3, 1824.

Tryon, Man. Conch., i, p. 142, pl. 51, figs. 128–130 (after Lesueur.)

A small, short-bodied species, with short, rounded caudal fins, very short upper arms, and large chromatophoric spots. Body short, thick, well-rounded, rather blunt posteriorly. Anterior edge of mantle with a well-developed median dorsal lobe, and well-marked lateral angles. Fins broad transversely, short, less than half the length of the mantle; outer edges well-rounded; posterior end very obtuse. Arms all short, the two upper pairs much shorter than the two lower, the dorsal pair very short, considerably shorter than the upper lateral ones; ventral and lower-lateral arms nearly equal in length. The dorsal arms are strongly compressed, with a well-marked thin dorsal keel; those of the second pair squarish at base,

without a keel; those of the third pair are strongly compressed, bent outward at base, and furnished with a high median keel, starting from the base, but highest in the middle; ventral arms triangular at base, with a wide membrane on the upper angle, which expands at the base, and connects them with the third pair; a narrower membrane runs along the ventral margins. Tentacular arms rather stout at base; compressed farther out, in extension about as long as the body; club well-developed, about twice as broad as the rest of the arm; its dorsal keel is thin, elevated, oblique, commencing at about the middle of the club and extending to the tip. The larger tentacular suckers are very regularly arranged in four rows, of 8 to 10 each, the lateral ones being not very much smaller than the median ones. The distal part of the club is covered with four regular rows of small suckers, and there is a terminal group of smaller, smooth-rimmed ones. The larger median suckers are broad cup-shaped, rather larger than the largest suckers of the lateral arms; their horny rims are armed with regular, sharp, incurved teeth, smaller on the inner side of the sucker, but there are few or no small teeth alternating with the larger ones. The lateral suckers are relatively large, deep cup-shaped, oblique, with very sharp incurved teeth on the outer margin. The membranous borders of the large suckers are covered with minute, sharp, chitinous scales.

The suckers of the short arms are very deep and oblique, cup-shaped; their rims are much the highest on the outer and distal side, where the edge is divided into several broad, bluntly rounded denticles, separated by narrow intervals.

The pen is short, with a broad-lanceolate blade; the narrow part of the shaft is short; a thin border, widening backward to the blade, commences about half way between the tip and the proper blade; the latter is broad and thin, marked with divergent lines; posterior end obtuse.

The color is peculiar. It consists, in alcoholic specimens, of dark purplish chromatophores, pretty uniformly and regularly scattered everywhere on the body, on a pale ground-color; when expanded the chromatophores are large and rounded; above the eyes they are so closely crowded as to form dark blotches; they also cover the outer surfaces of all the arms; under side of caudal fin white.

In alcohol, a medium-sized specimen measures, from tip of tail to base of dorsal arms, 80^{mm}; total length of mantle 71^{mm}; breadth of body, 22^{mm}; breadth of caudal fin, 52^{mm}; length of fin, 39^{mm}; length of dorsal arms, from base, 17^{mm}; of second pair, 23^{mm}; of 3d pair, 31^{mm}; of ventral arms, 31^{mm}; of tentacular arms, 46^{mm}; of club, 22^{mm}.

One specimen (♀) from Charlotte Harbor, Fla., is much larger than usual. It has the mantle 130mm long; diameter of body, 36mm; length of dorsal arms, 45mm; of 2d pair, 55mm; of 3d pair, 65mm; of tentacular arms, 145mm.

This species appears to have a wide distribution along the warmer parts of the American coast. The original specimen, described by Blainville, was from Brazil. D'Orbigny records it from Rio Janeiro. It extends northward to Delaware Bay. I have also seen specimens from Florida and from Mobile Bay, Alabama.

Loligo brevis.—Specimens examined.

No.	Locality.	Collected by	When rec'd.	Rec'd from.	Specimens. No.	Sex.
	Hampton, Va.	Dr. Marmion	1880	U. S. Nat. Mus.	1	♀
	St. John's River, Fla.	S. F. Baird	----	" "	1	♀
41	Charlotte Harbor, Fla.	----	----	Mus. Comp. Zoöl.	2	♀
641	Mobile, Alabama	Dr. Nott	Jan. 1857	" " "	3	♀
	Texas	Wurdemann	----	" " "	6	

Sepioteuthis sepioidea D'Orb.

Loligo sepioidea Blainville, Dict. Sci. Nat., xxvii, p. 146, 1823.

Sepioteuthis sepioidea D'Orbigny, Céph. Acétab., p. 298, *Sepioteuthes*, pl. 7, figs. 6–11; Hist. L'Ile de Cuba, Moll., p. 34, 1853.

Gray, Catal. Moll. Brit. Mus., i, p. 81, 1849.

Tryon, Man. Conch., i., p. 153, pl. 63, fig. 216. (Description copied from Gray; figure from D'Orbigny).

Although this species has not been recorded from north of Cape Hatteras, it is introduced here, because its common occurrence at the Bermudas and Florida renders it probable that it will, at times, be found farther north.

It differs from the related species in having a pen without any marginal thickenings; the lateral fins commence at a short distance behind the mantle edge (5mm to 8mm) and, taken together, have a long-rhomboidal figure, broadest nearly in the middle, and obtuse posteriorly; the sessile arms have wide marginal membranes; the dorsal arms are compressed, and much shorter than the others; the lower lateral arms are much the largest, with a strong dorsal keel; the suckers on the sessile arms are so crowded as to appear almost as if in four rows.

The tentacular club bears four regular rows of large suckers, the median ones but little larger than the lateral; small distal suckers in four regular rows, the lower ones largest. The larger suckers have regular, rather long and slender teeth, those on the inner edge

smaller. The suckers of the sessile arms are deep, very oblique, with a high rim, which has on the outer margin a number of regular, long, slender teeth, rather close together.

The whole surface is rather regularly and closely spotted with purple chromatophores.

The eggs are large, 5^{mm} to 8^{mm} in diameter, and comparatively few in number. In one female (No. 379) taken in July, the oviduct was distended with the eggs, which have a reticulated surface before reaching the glandular portion. This female had spermatophores attached to and around an elevated area on the inner ventral surface of the inner buccal membrane.

The oviduct is large and its external orifice has a wide ear-shaped border, more complicated than in *Loligo*. The nidamental glands correspond nearly with those of *Loligo*, but are relatively larger. In some of the males, taken in July, the spermatophore-sac and a saccular dilation near the orifice of the efferent duct, were filled with spermatophores, much like those of *Loligo*.

The male has the left ventral arm hectocotylized much as in *Loligo*. The stems of the suckers, for a considerable distance, toward the tip of the arm, become long, stout, conical, and many of them, in both rows, lack the rudimentary suckers.

This species is widely distributed along the tropical coasts of America, and throughout the West Indies. Martinique (Blainville); Honduras (Gray).

Specimens examined.

No.	Locality.	Collector.	Date.	Rec'd from	Specimens. No.	Sex.
	Bermudas	G. Brown Goode	1878	G. B. G.	1	
44	Key West, Fla.	Dr. J. B. Holder	1861	Mus. C. Zool.	2 l.	♂, br.
379	Fort Jefferson, Fla.	D. P. Woodbury	July, 1859	" "	1 l.	♀, br.
62	Cuba	Professor Poey	----	" "	2	♀, juv.

The genus *Sepioteuthis* is closely related to *Loligo* in all external characters, but its fins extend along nearly the whole length of the mantle, and the body is stouter, more ovate, and less pointed behind than in *Loligo*, so that the form is somewhat like that of *Sepia*. The pen is thin and lanceolate, nearly as in *Loligo*, but in many species the blade is thickened toward the margins. The internal anatomy is, however, very different from *Loligo*, in several respects. The ovary is short and thick, and confined more to the posterior portion of the body. The eggs are comparatively few and very large, being 5^{mm} to 8^{mm} in diameter, in our species.

Family SEPIOLIDÆ Keff.

Kefferstein, in Bronn, Thier-Reich. iii, p. 1443. 1866.
Gill, Arrangement of Families of Mollusca. p. 2, 1871.
Tryon, Man. Conch., i, pp. 102, 155, 1879.

Body short, thick, bluntly rounded posteriorly. Fins large, separate, laterally attached, on the middle of the sides of the body. Siphon with small internal valve; no dorsal bridles. A large brachial cavity, extending back beneath the eye, into which the tentacular arms can be more or less retracted. Pen little developed, lanceolate, not reaching the end of the mantle. Integument beneath the eye thickened so as to be used as a false eye-lid, in addition to the transparent skin over the eye. A lachrymal pore in front of each eye; a brachial pore between the third and fourth pairs of arms. Eggs large, few, not enclosed in capsules. Accessory nidamental glands well developed. Branchial chamber divided into two cavities by a median partition or septum, which extends forward to the base of the siphon. This family is, in many respects, closely related to *Loliginidæ*, but differs widely from the latter in its visceral anatomy.

SEPIOLA Leach.

Sepiola Leach, Zool. Miscel., iii, p. 137, 1817 (t. Gray).
D'Orbigny, Céph. Acétab., p. 224.
Gray, Catal. Moll. Brit. Mus., i, p. 91, 1849.

Body short, stout, rounded posteriorly. Fins large, narrowed at base. Mantle united directly to the head by a large, dorsal commissure; lateral connective cartilages of the mantle elongated, fitting into elongated margined pits on the base of the siphon. Siphon with an internal valve. A brachial aquiferous pore between the bases of the third and fourth pairs of arms, on each side. A lachrymal pore in front of each eye. Buccal membrane with seven lobes, without suckers. Tentacular arms more or less retractile into large cavities below the eyes; club with numerous, very small, nearly equal, long-pedicelled suckers, in eight or more rows; rims not toothed. The males differ from the females in having some of the middle suckers of the lateral arms much enlarged.

Sepiola leucoptera Verrill. (Butterfly Squid.)

Verrill, Amer. Journ. Sci., vol. xvi, p. 378, 1878.
Tryon, Man. Conch., i, p. 158, 1879. (Description copied from preceding).
Verrill, Amer. Journ. Sci., xix, p. 291, pl. 15, figs 4 and 5, April, 1880.

Plate XXXI, figures 4, 5. Plate LIV, figure 4.

Species rather small; the largest specimens observed are probably

full-grown. Body short, thick, swollen, with the mantle smooth. Ventral surface, in the middle, with a large, somewhat flattened, brown, heart-shaped or shield-shaped area, bordered with blue, and surrounded, except in front, by a silvery white band, having a pearly or opalescent luster. Eyes large, with roundish pupils. Fins large, thin, broadly rounded, in the living specimens nearly as long as the body; the posterior lobe reaches nearly to the end of the body; the anterior edge extends beyond the front of the mantle to the eye. The anterior edge of the mantle is emarginate beneath; it recedes laterally to a great extent; above, it is broadly attached to the head. Sessile arms, largely webbed, short; upper ones shortest; third pair longest; suckers in two rows. Tentacular arms slender, tapering, extending back to the end of the body; club not wider than the arm, with very minute suckers, in many rows.

Upper surface of the body opalescent in some lights, thickly spotted with orange-brown, spots most numerous in the middle line and extending to the upper surface of the head; some also occur on the outer surfaces of the arms; anterior part of the head white; fins, arms and extremity of body translucent bluish white; upper surface of the eyes opalescent, with silvery blue and red tints; head, below the eyes, silvery white; above the eyes, blue.

The largest specimen, (♂) taken in 1879, (Pl. XXXI, fig. 5), when living had the head, above, in front of the eyes, whitish, with a few chromatophores; back and the base of the fins thickly spotted with brown; posterior part of the back with an emerald-green iridescence. Sides of the body, below the fins, and posterior end of the body, silvery white. A large shield-shaped ventral area of brown, with a bright blue iridescence, and bordered with a band of brilliant blue, occupies most of the lower surface. Fins, transparent whitish, except at base. Lower side of head, siphon and outer bases of the arms, light brown. Eyes blue above, green below. The fins are large, nearly as long as the body.

Length of the original type-specimen (♀), to the base of the arms, 14^{mm}, in alcohol; of mantle, above, 8^{mm}; breadth, 7^{mm}; breadth across fins, 16^{mm}. The largest specimen, of 1879, is 31^{mm} (1·25 inch) long from end of body to base of arms; breadth of body, 25^{mm} (1 inch); length of arms, 19^{mm} (·75 inch).

The male (fig. 5) of this species differs from the female in having a group of three or four decidedly and abruptly larger suckers on the middle of the third pair of arms. (Pl. LIV, fig. 4); the other suckers, along the middle portion of these arms, are also larger than on the other arms.

This species is an exceedingly beautiful one, when living, owing to the elegance and brilliancy of its colors and the gracefulness of its movements. In swimming it moves its fins in a manner analogous to the motion of the wings of a butterfly. This fact, and its bright colors, suggested the English name that I have applied to it.

Three specimens, two very young, were taken by the writer and party, of the U. S. Fish Com., in the trawl-net, 30 miles east from Cape Ann, Mass., in 110 fathoms, August, 1878. One larger male was taken by us off Cape Cod in 122 fathoms, with the bottom temperature 41° F., August, 1879. The largest specimen seen was a male, taken in the same region, Sept. 10, 1879, in 94 fathoms. It was associated with *Octopus Bairdii* and *Rossia sublevis*.

Station.	Locality.	Fath.	When Collected.	Received from	Specimens. No.	Sex.
194	Gulf of Maine	110	Aug. 31, 1878	U. S. F. Com.	3 j.	
303	Off Cape Cod	122	Aug. 21, 1879	U. S. F. Com.	1	♂
342	Off Cape Cod	94	Sept. 10, 1879	U. S. F. Com.	1	♂

ROSSIA Owen.

Rossia Owen, Trans. Zool. Soc. London, 1828 (t. Gray); Owen, in J. Ross, Second Arctic Voyage, Appendix, p. xcii, pl. 100. 1835.
D'Orbigny, Céphal. Acétab., p. 242.
Gray, Catal. Moll. Brit. Mus., i, p. 88, 1849.

Mantle-edge free from the head dorsally, adhering by a longitudinal, ovate or horse-shoe-shaped connective cartilage, having a median and two lateral grooves, fitting into corresponding grooves on the cartilage of the mantle; two lateral, oblong, ridge-like cartilages, one on each side, also fit into ovate cartilage-pits on the base of the siphon. No olfactory crests. Pupils oblong or crescent-shaped, longitudinal. A false eye-lid below the eye. A pore in front of each eye, and one, on each side, between the bases of the third and fourth pairs of arms. Tentacular arms more or less retractile into large cavities at their bases, extending back beneath the eyes; club well developed, with numerous, nearly equal suckers, forming eight or more rows; rims not toothed; borders scaled. Buccal membrane with only six lobes, without suckers. The males differ from the females in having larger suckers on the middle of the lateral arms.

Rossia megaptera, sp. nov.

Plate XXXVIII, figure 1. Plate XLVI, figure 6.

Body short, broad, depressed, covered with a soft, flabby integument,

which forms a loose border posteriorly; the front edge of the mantle extends forward dorsally into a prominent angle, but recedes very much ventrally. Fins very large and broad; their anterior insertions being but little back of the antero-lateral edge of the mantle, and their posterior insertions close to the end of the body; the free borders of the fins are thin and undulated, extending forward anteriorly beyond the edge of the mantle, while the length, from base to outer edge, is about equal to the breadth of the back between the bases of the fins.

Head very large and broad, the width exceeding that of the body. Eyes very large and prominent; lower eyelids well developed, but not much thickened. Tentacles remarkably long and slender, in extension about twice as long as the head and body together. The tentacular club is somewhat thicker than the rest of the arm, rather long, narrow-lanceolate, tapering to the tip, and covered with numerous minute, globular suckers, arranged in many rows (Pl. XLVI, fig. 6, *b–d*). Sessile arms of moderate length, rounded, very slender at tip; the 1st, 2d and 3d pairs are successively longer, while the 4th or ventral pair is about equal to the first. Suckers, (Pl. XLVI, fig. 6, *a*), rather small, arranged in two rows on all the arms. On all the arms the suckers are similar but are a little larger on the 3d pair. They are nearly globular, with a rather wide aperture, which is surrounded by a border covered with numerous small scales, arranged in many rows; the scales of the marginal series are larger and project as fine denticles around the aperture. Color purplish brown, with rather large chocolate-brown chromatophores; outer portion of fins pale, thin and translucent; edges of mantle, siphon, under side of head and arms, and greater part of tentacular arms whitish, with only minute chromatophores.

Measurements of Rossia megaptera.

	Inches.	Millimeters.
Length, end of body to dorsal edge of mantle, exclusive of membrane,	1·25	32
Length, end of body to ventral edge of mantle,	·95	24
Length, end of body to base of dorsal arms,	2·25	57
Length, end of body to tip of dorsal arms,	3·40	86
Length, end of body to tip of 2d pair,	3 75	95
Length, end of body to tip of 3d pair,	4·08	103
Length, end of body to tip of 4th pair,	3·75	95
Length, end of body to tentacular arms,	7·45	188
Breadth of body and fins together,	2·50	63
Breadth of body between bases of fins,	·85	22
Breadth of body beneath fins, exclusive of membrane,	1·10	28

Measurements of Rossia megaptera. (*Continued.*)

	Inches.	Millimeters.
Breadth of head, across eyes,	1·40	36
Breadth of fins, antero-posteriorly,	1·08	27
Length of fins, base to outer edge,	·85	22
Diameter of eyes,	·75	19
Diameter of larger suckers of lateral arms,	·06	1·5
Diameter of larger suckers of club,	·01	·25
Breadth of club,	·16	4
Length of club,	·95	24

Off the southern coast of Newfoundland, in 150 fathoms, Capt. K. Markuson and crew, schooner "Notice," June, 1880.

This species is remarkable for the great size of the fins and eyes, and for the length of the tentacular arms. It appears to be a species specially adapted for inhabiting greater depths than the species hitherto discovered. It has the same soft, flabby integument observed in *Octopus lentus* and *Stauroteuthis syrtensis*, found at similar depths. But the looseness of the skin may be due in part to the condition of the specimens when preserved. The suckers on the tentacular arms are remarkably small.

Rossia Hyatti Verrill.

Verrill, Amer. Journ. Sci., vol. xvi, p. 208, 1878.

Tryon, Man. Conch., i. p. 160, 1879. (Description compiled from preceding).

Verrill, Amer. Journ. Sci., xix, p. 291, pl. 15, figs. 1 and 2, April, 1880.

Plate XXVII, figs. 8, 9. Plate XXX, fig. 1. Plate XXXI, figs. 1, 2. Plate XLVI, fig. 5.

Body subcylindrical, usually broader posteriorly; in preserved specimens, variable in form according to contraction. Dorsal surface covered with small, conical, scattered, whitish papillæ, which are also found on the upper and lateral surfaces of the head and bases of the arms; those around the eyes largest; one on the mantle, in the median line, near the front edge, is often elongated. Front border of mantle sinuous, slightly advancing in the middle, above. Fins moderately large, nearly semicircular, attached from the posterior end for about four-fifths the whole length, the front end having a small, rounded free lobe. The distance from the posterior junction of the fins to end of body is less than that from the anterior junction to edge of mantle, the center of the fin being at about the middle of the body. Siphon elongated, conical, with a small opening. Head depressed, more than half the length of the body. Eyes large, the lower eyelid prominent, but not much thickened. Sessile arms short, united at

their bases by a short web, which is absent between the ventral arms; the dorsals are shortest; the third pair the longest and largest; the second pair and ventrals about equal in length. Suckers, (Pl. XLVI, fig. 5, *a*), numerous, sub-globular, not very small, the margin bordered with several rows of minute scales; near the base of the arms they are biserial, there being usually four to six thus arranged in each row; then, along the rest of the length of the arms they become more crowded and form about four rows, those in the two middle rows alternating with those in the marginal rows; toward the tip they become very small and crowded, especially on the dorsal and ventral arms. The number of suckers varies with age, but on one of the larger specimens they were as follows: on each dorsal arm, sixty; on one of second pair, fifty-five; of third pair, fifty-three; of ventral, sixty-five. In this specimen (♀), the third arm of the right side and ventral arm of left side were abruptly terminated (accidentally), while the others were tapered to acute points. The tentacular arms, in preserved specimens, will extend back to the posterior end of the body; the naked portion is smooth, somewhat triquetral, with the outer side convex and the angles rounded; terminal portion widening rather abruptly, long ovate-lanceolate, curved and gradually tapered to the tip; the sucker-bearing portion is bordered by a wide membrane on the upper and a narrow one on the lower margin; the suckers (Plate XLVI, fig. 5, *b*, *c*,), are very small, sub-globular, crowded in about eight to ten rows in the widest portion.

The males differ from the females in the relatively greater size of the suckers on the middle of the lateral and ventral arms, those toward the tips becoming somewhat abruptly smaller, while in the female they decrease more gradually.

Color, pinkish, thickly spotted with purplish brown above, paler and more sparsely spotted beneath and on the outside of the long arms; the inner surface of the arms and front edge of the mantle are pale.

Length from bases of arms to posterior end of body, 40^{mm}; of body, 25; of head, 15; breadth of body, 17; of head 17; length of fins, 15; of insertion, 11; breadth of fin, 8; front of fin to edge of mantle, 5; length of free portion of dorsal arms, 12·5; of second pair, 15; of third pair, 18; of ventrals, 13; of tentacular arms, 40; breadth of dorsal arms, at base, 3·5; of second pair, 3·5; of third pair, 4; of ventrals, 3·5; of tentacular arms, at base, 2; at expanded portion, 3·5; length of latter, 10·5; diameter of largest suckers of sessile arms, 0·9; length of free portion of siphon, 7^{mm}.

One of the largest alcoholic specimens (♀), from station 218, has the mantle 31^{mm} long, dorsally; greatest breadth beneath the fins, 20^{mm}; length of fins longitudinally, 18^{mm}; transverse breadth of fins, 11^{mm}; length from end of body to tip of dorsal arms, 57^{mm}; to tip of second pair of arms, 59^{mm}; of third pair, 64^{mm}; of fourth pair, 59^{mm}.

Rossia Hyatti.—Specimens examined.

No.	Locality.	Fath.	Bottom.	When coll'd.	Rec'd from	Specimens. No. Sex.
				1877	U.S.F.C.	
30, 31	Off Salem, Mass.	48	mud	Aug. 13	"	2 j.
33	Off Cape Ann, 13 m.	90	mud	Aug. 14	"	1 l. ♂
42–46	Off Cape Sable, N. S., 30 m.	88–90	sand and mud	Aug. 21	"	1 ♂:1 ♀:3j.
48	Off Cape Sable, N. S., 20 m.	59	rocky	Aug. 21	"	1 j. ♀
85–86	Off Halifax, N. S., 26 m.	101	fine sand	Sept. 6	"	2 l. ♀
	Gulf of Maine and Massachusetts Bay.			1878		
130	Off Cape Ann, 14 m.	49	mud	July 23	"	3 j.
156	Off Gloucester, Mass., 8 m.	42	sand and mud	Aug. 15	"	2 j.
163	Off Cape Ann, 6½ m.	73	fine sand	Aug. 16	"	1 ♂:2 j. ♀
164	Off Cape Ann, 7 m.	75	fine sand	Aug. 16	"	1 ♀
181	Off Gloucester, Mass.	45	mud	Aug. 29	"	4 ♀
184	Off Gloucester, Mass., 5 m.	45	mud	Aug. 29	"	1 j.
211	Off Cape Ann, 6 m.	60	soft dark-br. mud	Sept. 17	"	1 j. ♂:1j. ♀
214	Off Cape Ann, 7 m.	57	fine mud and sand	Sept. 17	"	1 ♀
217	Off Cape Ann, 6 m.	45	soft dark-br. mud	Sept 18	"	1 l. ♂
218	Off Cape Ann. 6 m.	45	soft dark-br. mud	Sept. 18	"	1 l. ♀:1 j.
223	South of Cape Ann. 7 m.	47	soft brown mud	Sept. 21	"	1 ♂
234	Off Gloucester, Mass., 5½ m.	43	soft brown mud	Sept. 24	"	1 ♀
238	Off Gloucester, Mass., 4½ m.	43	soft brown mud	Sept. 26	"	2 j.
				1879		
264	Off Cape Cod, 15 m.	80	blue mud	July 29	"	1 l. ♂
276	Off Cape Cod, 6½ m.	47	blue mud	Aug. 1	"	1 l. ♀
324	Off Cape Cod, 11 m.	45	sand	Sept. 1	"	1 l. ♂
364	Off Cape Cod, 15 m.	70	sand	Sept. 18	"	1 l. ♀:3j. ♀
372	Off Chatham, Mass., 21 m.	70	sand	Sept. 19	"	1 ♂
						1 l. ♀
	Gloucester Fisheries.			1878.		
241	N. Lat. 44° 20′ W. Long. 59°	60		Dec.	"	1 j.
372	Off Miquelon I.	7		July '79	"	1 j.
39 Gl.	Off Gloucester, in Cod.	--		------	"	1 l. ♀

This species has been taken in numerous localities, by the dredging parties of the U. S. Fish Commission, in 1877, 1878 and 1879, off Cape Cod; in Mass. Bay, 40–50 fathoms; off Cape Ann, in the Gulf of Maine, 50–100 fathoms; off Cape Sable, N. S., 88–92 fathoms; off Halifax, N. S., 57–100 fathoms, on a fine compact sand and mud bottom. It occurs in from 40 to 100 fathoms. It has also been received through the Gloucester halibut fishermen, from the Banks, off Nova Scotia. One specimen (lot 241), presented by Capt. Chris. Olsen, and crew, of the schooner "William Thompson" was from N. Lat. 44° 20′;

W. Long. 59°, in 60 fathoms; another from 7 fathoms, off Miquelon I., (lot 372), was presented by Capt. C. D. Murphey and crew, of the schooner "Alice M. Williams." Its relatively large eggs (Pl. XXVII, fig. 9) are laid in August and September, in small clusters, slightly attached together, in the large oscules or cavities of several species of sponges.

It is frequently associated with *Octopus Bairdii* V., and the following species.

This species has a strong general resemblance to *R. glaucopis* Lovén, as figured in the admirable work of G. O. Sars but the latter has shorter lateral arms, and the suckers of the sessile arms are in two rows, while they are four-rowed in our species.

Rossia sublevis Verrill.

Rossia sublevis Verrill, Amer. Jour. Sci., vol. xvi, p. 209, 1878.

Tryon, Man. Conch., i, p. 160, 1879. (Description compiled from preceding.)

Verrill, Amer. Journ. Sci., xix, p. 291, pl. 15, fig. 3, Apr., 1880; Bulletin Mus. Comp. Zool., viii. p. 104, pl. 3, figs. 2–4: pl. 7, fig. 4, 1881.

PLATE XXX, FIGURE 2, ♀. PLATE XXXI, FIGURE 3, ♀. PLATE XLVI, FIGURE 4. PLATE XLVII, FIGURES 2–3. ♀, FIGURE 4, ♂.

Larger and relatively stouter than *Rossia Hyatti*, with the fins larger and placed farther forward, the rounded front edge of the large free lobe reaching nearly to the edge of the mantle. Head large and broad. Eyes very large.

Sessile arms more slender and less unequal in size than in the preceding species, and with the suckers arranged in two regular rows throughout the whole length. Anterior edge of the mantle scarcely sinuous, advancing but little dorsally. Upper surface of the body and head nearly smooth, but in the larger specimens, especially the males, usually with a few very small whitish papillæ, most numerous near the front edge of the mantle. Color, nearly as in the preceding species.

The pen (Plate XLVI, figure 4) is small and thin, much shorter than the mantle. The shaft is narrow; the blade is rather abruptly wider and rather shorter than the shaft; its posterior portion is very thin, with the edge ill-defined.

The males, when adult, can be easily distinguished from the females, by the larger size of the suckers along the middle of the two lateral pairs of arms (Plate XLVII, figure 4), and, to a less extent, of the ventral pair. These large suckers are oblong, with a groove or constriction around the middle, the part below the groove larger

than that above it; the aperture is small, ovate, with a smooth rim; their pedicels are short and laterally attached. In the female the corresponding suckers are not only smaller but are differently shaped, the basal portion being smaller than the upper portion. The suckers of the tentacular arms are very numerous, minute, shallow, cup-shaped, with oblique rims and slender pedicels; they are nearly equal and appear to form eight to twelve rows.

Young specimens, with the mantle less than 12^{mm} in length, can scarcely be distinguished sexually by external characters, and are not easily distinguished from the young of *Rossia Hyatti*, of similar size.

One of the original specimens (♀) measured, from the base of the arms to the end of the body, 46^{mm}; length of body, 31; of head, 15; breadth of body, 22; of head, 23; length of fins, 20; of their insertion, 16; breadth of fins, 10; front edge of fin to edge of mantle, 2·5; length of free portion of dorsal arms, 16; of second pair, 17; of third pair, 20; of ventrals, 15; of tentacular arms, 25; breadth of dorsal arms at base, 3; of second pair, 3; of third, 3·5; of ventrals, 3·5; of tentacular arms, 3·5; of the terminal portion, 3·75; its length, 10; diameter of the largest suckers of sessile arms, ·8; length of free portion of siphon, 7^{mm}.

Measurements of Rossia sublevis and R. Hyatti, in millimeters.

	R. sublevis.		R. Hyatti.	
Sex	♂	♀	♂	♀
Station	879	894	324	218
Length of mantle, above	29	32	21	31
Breadth of mantle	22	25	17	19
Breadth across head	26	30	15	20
Diameter of eyes	16	16	8	9
Length of a fin	21	24	11·5	17
Length of its base	17	19	10	12
Transverse breadth of a fin	14	15	7	10·5
Length to base of dorsal arms*	45	47	31	45
" " " third pair	46	47	32	43
" " " ventral arms	41	43	26	39
" tip " dorsal arms	64	71	42	58
" " " second pair	65	75	43	59
" " " third pair	66	78	46	64
" " " ventral pair	61	74	42	60
Length of tentacular club	9	15	7	10
Its breadth	2·5	3	2	2·5
Diameter of largest suckers of lateral arms	2·2	1.1	1·5	.8

* The length to the 'bases' of the arms, is from the posterior end of the body to the free edge of the basal web, between the arms; that of the third pair is to the edge of the web, between the second and third pairs. The measurements are all from well preserved alcoholic specimens.

One of the specimens (No. 16), taken by Mr. Agassiz, in 357 fathoms, is a young female differing somewhat from the others in having the arms shorter, with the suckers more crowded, so that they apparently form more than two rows. Possibly this should be referred to *R. Hyatti* Verrill. Its back is smooth. All three specimens from this same region differ somewhat from those taken farther north, in shallower water, in having larger eyes and shorter and stouter arms.

Rossia sublevis.—Specimens examined.

Stat.	Locality.	Fath.	Bottom.	When coll'd.	Rec'd from	Specimens. No. Sex.
				1877	U.S.F.C.	
84	Off Halifax, N. S., 26 miles	101	fine sand	Sept. 6	"	1 l. ♀ : 1 j.
85, 86	Off Halifax, N. S., 26 miles	101	fine sand	Sept. 6	"	1 ♂ : 1 j. ♀
100	Off Halifax, N. S.	42	fine sand	Sept. 15	"	eggs & juv.
				1878		
161	Off Cape Ann, 6 miles	54		Aug. 6	"	1 l. ♂
194	Off Cape Ann, 33 miles	110	muddy	Aug. 31	"	
				1879		
264	Off Cape Cod, 15 miles	80	blue mud	July 29	"	1 ♂ :11. ♀ :3j.
324	Off Cape Cod, 11 miles	45	sand	Sept. 1	"	1 l. ♂
364	Off Cape Cod, 15 miles	70	sand	Sept. 18	"	1 j.
	Off Newport, R. I.					
	N. lat. W. long.			1880		
869	40° 02′ 18″ ; 70° 23′ 06″	192	fine sand and mud	Sept. 4	"	1 ♂ :5 ♀
870	40 02 36 ; 70 22 58	155	fine sand and mud	Sept. 4	"	1 ♂ :1 ♀
880	39 48 30 ; 70 54 00	252	fine sand and mud	Sept. 13	"	1 l. ♂
893	39 52 20 ; 70 58 00	372	mud, fine sand	Oct. 2	"	1 j.
894	39 53 00 ; 70 58 30	365	mud, fine sand	Oct. 2	"	1 l. ♂ : 1 j. ♀
895	39 56 30 ; 70 59 45	238	mud, fine sand	Oct. 2	"	11. ♂ :11. ♀ :5
897	Off Chesapeake Bay	157		Nov. 16	"	1 l. ♂ [eggs
	Blake Exped. U. S. Coast Survey.					
310	39° 59′ 16″ ; 70° 18′ 30″	260		1880	A. Agas.	1 ♀ ad.
320	32 33 15 ; 77 30 10	257		1880	"	1 ♀ ad.
321	32 43 25 ; 77 20 30	233		1880	"	1 ♀ j. ?
	Gloucester Fisheries.					
265	42° 49′ ; 62° 57′	250		Jan.'79	U.S.F.C.	1 j.

This has been taken, by the dredging parties of the U. S. Fish Commission, in the trawl-net, at various localities, in 1877, 1878, and 1879, in 45 to 110 fathoms, off Massachusetts Bay, off Cape Cod, and off Halifax, N. S. It has been brought in by Capt. J. W. Collins and crew, of the schooner "Marion," (lot 265) from the banks off Nova Scotia. It was trawled in some numbers, and of both

sexes, by the U. S. Fish Commission, in 1880, off Newport, R. I., in 155 to 372 fathoms; and in November, 1880, by Lieut. Z. L. Tanner, on the "Fish Hawk," off the mouth of Chesapeake Bay, in 157 fathoms. It was taken by Mr. Agassiz, on the "Blake," in 233–260 fathoms, and as far south as lat. 32° 33′ 15″.

This species very closely resembles the *Rossia glaucopis* Lovén, of Northern Europe, as figured by G. O. Sars. The latter is, however, more papillose, and has smaller eyes and head, if correctly figured.

HETEROTEUTHIS Gray.

Heteroteuthis (sub-genus) Gray, Catal. Moll. Brit. Mus., i, p. 90, 1849.

The body is short, thick, rounded posteriorly. Fins large, with narrower bases, attached near the middle of the sides of the mantle. Head and eyes large. Anterior border of the mantle-edge free, dorsally. Connective cartilages on the base of the siphon, with an ovate pit; lateral cartilages of mantle, simple, longitudinal ridges. Pen much shorter than the mantle, narrow anteriorly; posterior blade small, slightly expanded laterally. Club of the tentacular arms well developed, with numerous suckers, in about eight rows, those in the lower marginal rows decidedly larger than the rest; rims of the suckers with smooth edges; the membranous edge of the aperture is denticulated by small, acute scales. Middle suckers of the lateral and ventral arms distinctly larger in the female; in the male abruptly very much larger than on the others; these suckers are deep, with a small, round, smooth rim, and with a raised zone around the middle. In the male the left dorsal arm is hectocotylized by having much smaller and more numerous suckers, arranged in four rows, and by the development of the marginal membrane.

Heteroteuthis tenera Verrill.

Amer. Jour. Sci., xx, p. 392, November, 1880; Proc. Nat. Mus., iii, p. 360, 1880; Bull. Mus. Comp. Zool., viii, p. 103, pl. 3, figs. 5–5*b*, pl. 8, figs. 2–2*d*, 3–3*b*, 1881.

PLATE XLVI, FIGURES 2–2*d*, 3–3*b*. PLATE XLVII, FIGURES 5–5*b*.

A small and delicate species, very soft, translucent, and delicately colored when living.

Body short, cylindrical, scarcely twice as long as broad, posteriorly; usually round, but in strongly contracted, preserved specimens, often narrowed and even obtusely pointed; front edge of mantle sometimes with a slight dorsal angle, in most cases emarginate. Fins very large, thin, longer than broad, the outer edge broadly rounded, the

anterior edge extending forward quite as far as the edge of the mantle, and considerably beyond the insertion of the fin, which is itself well forward. The length of the fin is about two-thirds that of the body; the base or insertion of the fin equals about one-half of the body-length; the breadth of the fin is greater than one-half the breadth of the body. Head large, rounded, with large and prominent eyes; lower eyelid slightly thickened. Arms rather small, unequal, the dorsal ones considerably shorter and smaller than the others. In the male, the left dorsal arm is greatly modified, and very different from its mate. Lateral and ventral arms are subequal.

In both sexes, and even in the young, the suckers along the middle of all the lateral and ventral arms are distinctly larger than the rest, but in the larger males this disparity becomes very remarkable, the middle suckers (Pl. XLVI, figs. 3*a*–3*b*) becoming greatly enlarged and swollen, so that eight to ten of the largest are often six or eight times as broad as the proximal and distal ones; they are deep, laterally attached, with a raised band around the middle, and a very small round aperture, furnished with a smooth rim. In the female the corresponding suckers on the lateral arms are about twice as broad as the rest. The suckers are in two regular rows, on the lateral and ventral arms, in both sexes. In the male, the left dorsal arm becomes thickened and larger from front to back, and is usually curled backward; its suckers become smaller and much more numerous than on the right arm, being arranged in four crowded rows, except near the base, where there are but two; the sucker-stalks also become stout and cylindrical, or tapered, their diameter equalling that of the suckers (Pl. XLVI, fig. 3; Pl. XLVII, fig. 5). The right arm remains normal, with two alternating rows of suckers, regularly decreasing to the tip, as in both the dorsal arms of the female. Tentacular arms long, slender, extensible; club distinctly enlarged, usually curled in preserved examples (Pl. XLVI, figs. 2*a*, 3). The suckers on the club are numerous, unequal, arranged in about eight close rows; those forming the two or three rows next the upper margin (Pl. XLVII, figs. 5*a*–5*b*) are much larger than the rest, being three or four times as broad, and have rows of small scale-like denticles around the rims, the marginal ones larger.

Color, in life, pale and translucent, with scattered rosy chromatophores. In the acoholic specimens, the general color of the body, head, and arms is reddish, thickly spotted with rather large chromatophores, which also exist on the inner surface of the arms, between the suckers, and to some extent on the tentacular arms and bases of the

fins; outer part of fins translucent white; anterior edge of mantle with a white border.

Pen small and very thin, soft, and delicate. It is angularly pointed or pen-shaped anteriorly, the shaft narrowing backward; a thin lanceolate expansion, or margin, extends along nearly the posterior half (Pl. XLVI, fig. 2*b*).

Upper jaw with a sharp, strongly incurved beak, without a notch at its base. Lower jaw with the tip of the beak strongly incurved, and with a broad, but prominent, rounded lobe on the middle of its cutting edges (fig. 2*c*).

Odontophore with simple, acute-triangular median teeth; inner laterals simple, nearly of the same size and shape as the median, except at base; outer laterals much longer, strongly curved forward (fig. 2*d*.)

Length of body 25 to 40^{mm}. One of the larger males measures, in alcohol, from the posterior end of the body to the dorsal edge of the mantle, 21^{mm}; to the free bases of the dorsal arms, 48^{mm}; to the interval between bases of second and third pairs, 49^{mm}; to bases of ventral arms, 46^{mm}; to tip of dorsal arms, 48^{mm}; of second pair, 51^{mm}; of third pair, 49^{mm}; of ventral arms, 46^{mm}; diameter of largest suckers of lateral arms, 2^{mm}; length of fin at base, 11^{mm}; extreme length of fin, 15·5^{mm}; transverse breadth of fin (lower side), 10^{mm}; diameter of eye, 9^{mm}; breadth of body, below fin, 17^{mm}; breadth of head, 17^{mm}.

Twenty-seven specimens of this species were obtained by Mr. A. Agassiz, on the "Blake," in 1880, from six stations, ranging in depth from 71 to 233 fathoms. Later in the same season, over 200 specimens were secured by the writer and others of the dredging party on the United States Fish Commission steamer "Fish-Hawk." It was particularly abundant at stations 869, 870 and 871, in about 125 to 192 fathoms, on the rapidly sloping outer bank, off the coast, under the inner edge of the Gulf Stream, where the bottom consists of fine compact sand, with mud and shells. Both sexes occurred in about equal numbers, and also the young, of various sizes. It was also taken in considerable numbers at stations 865 to 867, in 65 fathoms; 872 to 880, in 85 to 252 fathoms. It was also dredged off the mouth of Chesapeake Bay, in November, by Lieut. Z. L. Tanner, on the "Fish Hawk," in 18 to 57 fathoms.

It is easily distinguished from all the species of *Rossia* by the larger size of the suckers along the middle of the lateral arms; by the inequality of the suckers on the tentacular clubs; and by the peculiar hectocotylized condition of the left dorsal arm of the male. The ex-

istence of large chromatophores on the inner surface of the arms, between the suckers, is also a good diagnostic mark, by which to distinguish it from our species of *Rossia*, which have the corresponding parts nearly white, or with few and small chromatophores.

Heteroteuthis tenera.—Specimens examined.

Stat.	Locality. N. Lat.	W. Long.	Depth, Fathoms.	When received.	Specimens. No. Sex.
	U. S. Fish Com. Off Martha's Vineyard.			1880	
865	40° 05′	70° 23′	65	Sept. 4, U. S. F. C.	3 ♂ 7 ♀
866	40 05 18″	70 22 18″	65	" " "	3 ♂ 6 ♀
867	40 05 42	70 22 06	64	" " "	4 ♂ 10 ♀
869	40 02 18	70 23 06	192	" " "	20+, ♂ & ♀
870	40 02 36	70 22 58	155	" " "	15 ♂ 17 ♀
871	40 02 54	70 23 40	115	" " "	18 ♂ :11 ♀ :32 j
872	40 05 39	70 23 52	86	" " "	1 ♂ 2 ♀
	Off Newport, R. I.				
873	40° 02′	70° 57′	100	" 13, " "	5 ♂ 1 ♀
874	40 00	70 57	85	" " "	10 ♂ 6 ♀
875	39 57	70 57 30″	126	" " "	1 ♂
876	39 57	70 56	120	" " "	8 ♂ 6 ♀
877	39 56	70 54 18	126	" " "	6 ♂ 4 ♀
878	39 55	70 54 15	142½	" " "	1 ♂ 1 ♀
879	39 49 30″	70 54	225	" " "	6
880	39 48 30	70 54	252	" " "	2 ♂
	Off Chesapeake Bay.				
899	37° 22′	74° 29′	57½	Nov. 16, " "	3 ♂ 2 ♀
900	37 19	74 41	31	" " "	1 j.
901	37 10	75 08	18	" " "	21 ♂ 3 ♀
	Blake Expedition, U. S. Coast Survey.				
313	Off Charleston, S. C.		75	1880	7 ♂ 5 ♀
314	32° 24′	78° 44′	142	1880	2 ♂ 1 ♀
316	32 7	78 37 30″	229	1880	1 ♀ j.
321	32 43 25″	77 20 30	233	1880	5 ♀
327	34 0 30	76 10 30	178	1880	1 ♂ 3 ♀
345	40 10 15	70 4 30	71	1880	2 ♀ j.

Order II.—OCTOPODA Leach.

Cephalopoda octopoda Leach, Zool. Miscel., iii, 1817 (t. Gray).

Férussac Tableau Syst., p. 18. 1821.

D'Orbigny, Tab. Method., p. 45, 1825; D'Orbigny, Céphal. Acétab., p. 1.

Octocera Blainv., Dict. Sci. Nat., vol. xxxii. 1824.

Octopia Gray, Cat. Moll. Brit. Mus., i, p. 3, 1849.

Arms eight, similar, all furnished with suckers in one or two rows; often more or less united by a web, without natatory crests. Suckers sessile, not oblique, destitute of horny rings or hooks. No tentacular arms. Head often larger than the body. Body short and

thick, obtuse posteriorly, usually destitute of fins. Fins, when present, small, lateral, supported by an internal transverse cartilage. Mantle usually extensively united to the head by a dorsal commissure. Siphon without an internal valve. Branchial cavity divided into two parts by a median septum, extending forward to the base of the siphon, but interrupted posteriorly. No olfactory crests. Eyes united to the internal lining of the sockets, so as to be immovable, usually furnished with lids. No outer buccal membrane. Aquiferous pores and cavities usually absent; cephalic pores sometimes present. Internal longitudinal shell or pen absent. An external shell is present only in the genus Argonauta. In this case it is formed as a secretion from the inner surface of the expanded distal portion of the two dorsal arms, of the female only, and serves mainly as a receptacle for the eggs. The right arm of the third pair is hectocotylized in the male. Sometimes the entire arm is modified and sometimes the tip only.

Family PHILONEXIDÆ D'Orbigny.

Philonexidæ (*pars*) D'Orb., Moll. Viv. et Fos., i, 199, 1845 (t. Gray).
Gray, Catal. Moll. Brit. Mus., i, p. 24, 1849.
Kefferstein, in Bronn, Thier-Reich., iii, 2 B., p. 1449, 1866.

Body stout, oval, destitute of lateral fins. Branchial opening large. Edge of mantle united to the base of the siphon laterally by a complicated prominent cartilage or button fitting in a corresponding pit on the inner surface of the mantle. Dorsal commissure narrow. Head with aquiferous pores communicating with large aquiferous cavities. Arms simple, more or less united by webs. Suckers prominent.

In the male, the hectocotylized arm is developed in a sac, the entire arm being modified, and usually, when perfected, it becomes detached from the body. Probably this arm is lost and regenerated each year.

Parasira Steenstrup.

Parasira Kefferstein, in Bronn, Thier-Reich., iii, p. 1449, 1866.
Tryon, Man. Conch., i, p. 104.

Body short, thick, pouch-like, usually ornamented with raised ridges. Mantle united directly to the head dorsally; laterally connected to the base of the siphon by a pit and raised cartilaginous tubercle on each side, which fit corresponding pits and tubercles, near the base of the siphon (something as a button fits into a buttonhole), so that it can be separated only with considerable difficulty.

Gill-opening very wide, extending upward beyond the eyes. Arms long, slender; web rudimentary. Suckers prominent, in two alternating rows. Siphon large, intimately united to the whole length of the lower side of the head; its free extremity is situated far forward, between the ventral arms.

The sexes are widely different. The hectocotylized arm of the male is developed in a pedunculated sac.

There is a large aquiferous pore just behind the base of each ventral arm, at the sides of the siphon; these connect with large, cephalic, aquiferous cavities. The connective cartilages on each side of the base of the siphon consist of a prominent button, with an expanded and recurved anterior edge, which fits into a corresponding deep pit in the mantle-cartilage; and a deep, triangular pit, in front of the button, which receives the pointed, angular, cartilaginous tubercle of the mantle-cartilage. The posterior border of the base of the siphon forms a broad collar, within the mantle border. The lateral openings to the gill-cavity, on the sides of the neck, extend up as far as the upper side of the eyes; opposite and below the eyes, they are large, but internally are interrupted by two muscular bands on each side, one running back from the head to the mantle and one going back from the base of the siphon, opposite the connective cartilage.

The median septum of the gill-cavity is strong, but short, commencing a little behind the base of the siphon and extending only a short distance back, but expanding in length as it joins the ventral surface of the mantle; behind it the two halves of the gill-cavity are connected by a wide opening. The peritoneal membrane is strong, and specked with dark chromatophores.

Parasira catenulata Steenstrup.

Octopus tuberculatus Risso (?), Hist. nat. de l'Eur. mérid., iv, p. 3, 1826 (t. d'Orb.)
Octopus catenulatus Férussac, Poulpes, pl. 6, bis, ter., 1828 (t. D'Orbig.)
Philonexis tuberculatus Fér. and D'Orb., Céph. Acét., p. 87, pl. 6, bis, ter.
Parasira catenulata Steenstrup.
Verrill, Amer. Journ. Sci., xix, p. 293, Apr., 1880.

PLATE XXXIII, FIGURES 2, 2*a*.

Female: Body relatively large, swollen, rather higher than broad, dilated below, larger in front, obtusely rounded posteriorly; upper surface smooth or finely wrinkled; lower surface covered with prominent, rounded verrucæ or small hard tubercles, which are connected together by raised ridges, five (sometimes six) of which usually run to each tubercle, thus circumscribing angular depressed areas, each

of which usually has a dark-colored spot in the center; on the sides, these tubercles are less prominent and less regular, gradually fading out above. The head is decidedly smaller than the body, and smooth both above and below. The eyes are prominent, but the external opening is small, round, with simple border. The gill-opening is large, and extends upward on the sides of the neck to the level of the upper sides of the eye-balls. The siphon-tube is completely united by its basal portion to the lower side of the head; its free portion is large and elongated, standing out well forward, between the bases of the ventral arms. There is a conspicuous aquiferous pore at each side of the base of the siphon, just back of the ventral arms. The arms are stout, not very long; the inner surface is broad, with two rows of rather widely separated suckers, which run along the margins of the arms; the suckers are rather large, and considerably raised on stout bases; the first suckers form a regular circle around the mouth; two or three basal suckers are nearly in a single row. The suckers are cup-shaped, with a deep central pit, around which there are strong radial ridges; toward the base of the arms the soft swollen rims of the suckers are wrinkled and lobulated; farther out they are smooth and even. The beak is black, with sharp tips. It is surrounded by a thick, wrinkled buccal membrane.

The arms are slightly united at their bases by a narrow web, which also runs along each of the outer angles of the six upper arms, forming more or less wide marginal membranes, according to the state of extension, and by their contractions causing the arms to curl in various directions; one of these membranes frequently disappears, if the other be so stretched as to become wide, when the arm is strongly recurved; on the ventral arms the upper membrane becomes strongly developed, while the lower one is abortive. There is also a slight marginal membrane along the inner margins, running between the suckers and connecting them together. The dorsal and ventral arms are considerably larger and longer than the two lateral pairs, the dorsal ones are the stoutest. The two lateral pairs are about equal in size and length. On the dorsal arms there are about 96 suckers; on the lateral ones about 80, that can be counted with the naked eye. The tips are very slender and covered with very minute suckers.

Color of the body and head, above, and of the upper arms, deep brownish purple; lower surfaces of body and head, with the siphon and ventral arms, pale yellowish.

The total length of our specimen is 203^{mm}; of mantle, 51; circum-

ference of body, 152; length of dorsal arms, from eye, 137; second pair, 94; of third pair, 84; of fourth pair, 134·5.

A specimen of this interesting species was taken in Vineyard Sound, Mass., by Mr. V. N. Edwards, in 1876. It was not known previously from the American coast, and has been regarded as peculiar to the Mediterranean and West Indies.

Measurements of Parasira catenulata.

			Left Side.	
	mm.	inches.	mm.	inches.
From base of arms to tip of tail	70	2·75		
From base of arms to mantle	20	·80	81	3·2
From edge of mantle to tip of tail	51	2·00		
From edge of mantle to tip of tail (below)	81	3·2		
Tail to eye	66	2·60		
Circumference of body	152	6·00		
Breadth of body	51	2·00		
Circumference of head	109	4·30		
Breadth of head	38	1·50		
Diameter of eyes	2·5	·10		
Diameter of largest suckers	3·5	·14		
Length of dorsal arms, first pair, from eye	134	5·30	109	4·30
" " " second " "	93	3·70	96	3·80
" " " third " "	92·5	3·68	89	3·50
" " " fourth " ventral	149	5·88	134	5·30
Breadth of first pair of arms at base	7·5	·30	8·75	·35
" " second " " "	7	·28	7	·28
" " third " " "	6·25	·25	6·25	·25
" " fourth " " "	7·5	·30	7·5	·30
Length of siphon	58	2·30		
Breadth of base of free part	11·25	·45		
Breadth at tip	7·5	·30		

The remarkable tubercles of the ventral surface mostly have five ridges converging to each, rarely six. In all other respects it agrees with the figures of Férussac and D'Orbigny. According to Targioni-Tozzetti, *P. catenulata* is distinct from *P. tuberculata*. If so, our species should bear the former name.

Family ARGONAUTIDÆ Cantr.

Cantraine, Mall. Médit., p. 13, 1841; H. & A. Adams, Genera, i, p. 23.
Octhoidæ Gray, Catal. Moll. Brit. Mus., i, p. 28.

Argonauta argo Linné.

Shells of this species, some of them entire, were taken by the "Fish Hawk" at several of the stations 70 to 115 miles south of Martha's Vineyard and Newport, R. I., in 64 to 365 fathoms. At least nine specimens were dredged. At Station 894, in 365 fathoms, two entire and nearly fresh shells were taken, and another

nearly complete. They belong to the common Mediterranean variety. Fragments were also taken at Stations 865–7, 871, 873, 876, 892, 895.

The capture of a living specimen, probably of this species, on the coast of New Jersey, has been recorded by Rev. Samuel Lockwood, Amer. Naturalist, xi, p. 243, 1877.

Family ALLOPOSIDÆ Verrill, nov.

Body thick, obtusely rounded; arms extensively webbed; mantle-edge united directly to the head, not only by a large dorsal commissure, but also by a median-ventral and two lateral longitudinal commissures, which run from its inner surface to the basal parts of the siphon.

The male hectocotylized right arm of the third pair is developed in a cavity in front of the right eye and, when mature, protrudes from an opening on the inner surface of the web, between the second and fourth pairs of arms, and finally becomes detached. It is furnished with two rows of large suckers, and with a fringe along the sides. The mode of attachment of the mantle to the head is similar to that of *Desmoteuthis*, among the ten-armed cephalopods.

Alloposus Verrill.

Amer. Journ. Sci., xx, p. 393, Nov., 1880; Proc. Nat. Mus., iii, p. 362, Dec., 1880; Bulletin Mus. Comp. Zool., viii, p. 112, March, 1881.

Allied, in some respects, to *Philonexis* and *Tremoctopus*. Body thick and soft, smooth; arms (in the male only seven) united by a web, extending nearly to the ends; the length of the arms decreases from the dorsal to the ventral ones; suckers sessile, simple, in two rows; mantle united firmly to the head by a ventral and two lateral muscular commissures, the former placed in the median line, at the base of the siphon; free end of the siphon short, well forward.

In the male, the hectocotylized right arm of the third pair is developed in a sac in front of the right eye (Plate L, figs. 1, 1*a*); as found in the sac, it is curled up and has two rows of suckers; the groove along its edge is fringed; near the end, the groove connects with a rounded, obliquely placed, broad, flat or slightly concave lateral lobe, with transverse wrinkles or plications on the inner surface; the terminal portion of the arm is a long fusiform process.

Alloposus mollis Verrill.

Amer. Jour. Sci., xx. p. 394, Nov., 1880; Proc. Nat. Mus.. iii, p. 363, 1880; Bulletin Mus. Comp. Zool., viii, p. 113, pl. 4. fig. 4; pl. 8, figs. 1–2*a*, March, 1881.

Plate L, figs. 1, 1*a*, 2, 2*a*. Plate LI, fig. 4.

Body stout, ovate, very soft and flabby. Head large, as broad as the body; eyes large, their openings small. Arms rather stout, not very long, webbed nearly to the ends, the dorsal much longer than the ventral arms; suckers large, simple, in two alternating rows. Color deep purplish brown, with a more or less distinctly spotted appearance. Total length of a medium sized specimen, 160^{mm}; of body, to base of arms, 90^{mm}; of mantle, beneath, 50^{mm}; of dorsal arms, 70^{mm}; breadth of body, 70^{mm}. Other specimens are about one-third larger. The sexes scarcely differ in size.

One mature, detached, hectocotylized arm (Plate LI, fig. 4) was taken November 16. This has two rows of large, six or seven-lobed suckers, a very long fringe, composed of thin, flat, lacerate processes, along each side; the terminal process is fusiform, acute, and loosely covered with a thin, translucent membrane, beneath which the inner surface, bearing chromatophores, can be seen. Length of this arm, 200^{mm}; its breadth, 20^{mm}; length of terminal process, 30^{mm}; its diameter, 7^{mm}; diameter of largest suckers, 6^{mm}; length of fringe, 15^{mm}.

Taken by the "Fish Hawk," at Stations 880, 892, 893, 895, about 100 to 115 miles south of Newport, R. I., in 225 to 487 fathoms. Also, off the mouth of Chesapeake Bay, at Station 898, November 16, in 300 fathoms, by Lieut. Z. L. Tanner.

Specimens examined.

Station.	Locality.	Fath.	When received.	Received from.	Specimens.
	OFF NEWPORT, R. I.				
	N. lat. W. long.				
880	39° 48′ 30″ 70° 50′ 00″	252	Sept. 13, 1880	U. S. Fish Com.	2 ♂ : 1 ♀
881	Farther southward	325	Sept. 13, 1880	do	1
892	39° 46′ 00″ 71° 05′ 00″	487	Oct. 2, 1880	do	1
893	39° 52′ 20″ 70° 58′ 00″	372	Oct. 2, 1880	do	2
895	39° 56′ 30″ 70° 59′ 45″	238	Oct. 2, 1880	do	1
	OFF CHESAPEAKE BAY.				
898	37° 24′ 00″ 74° 17′ 00″	300	Nov. 16, 1880	do	1

Family OCTOPODIDÆ D'Orbigny, (restricted).

Octopodidæ (*pars*) D'Orbigny, Moll. Viv et Fos., i, 159, 164, 1845 (t. Gray); (*pars*) Céphal. Acétab., p. 3.
Octopidæ (*pars*) Gray, Catal. Moll. Brit. Mus., i, p. 4, 1849.

Body short, thick, rounded posteriorly, destitute of lateral fins and internal cartilages. Mantle united to the head by a broad dorsal commissure. Head very large. Connection between the mantle and base of siphon simple, without cartilages. Opening to the gill-cavity narrow. Median septum of branchial cavity short, extending forward to the base of the siphon, but running back only a short distance. Siphon large, simple. Arms with either one or two rows of suckers, and with a more or less developed basal web. No cephalic aquiferous pores. Eyes furnished with an internal translucent lid, and also capable of being covered with the external integument. Sexes similar externally, except that the right arm of the third pair in the male is hectocotylized by the formation of a spoon-shaped organ at the tip.

OCTOPUS Lamarck, 1799.

Octopus (*pars*) Lamarck, Syst. des Anim. sans Vert., p. 60, 1801.
Cuvier, Rég. Anim., ii, 1817.
D'Orbigny, Céphal. Acétab., p. 3.
Gray, Catal. Moll. Brit. Mus., i, p. 4, 1849.

Body short, thick, more or less rounded, usually flattened, often tubercular or warty, but sometimes smooth, usually with one or more tubercles or cirri situated above the eye. Mantle directly united to the head, dorsally, by a broad commissure, extending below the eyes to the base of the siphon. Base of the siphon without any complicated connective cartilages. Arms united by a more or less extensive basal web. Suckers sessile, in two alternating rows. Siphon not intimately united to the whole length of the under side of the head, the free terminal portion situated behind or beneath the eyes. No aquiferous pores, nor brachial pouches.

The sexes are similar in form. In the male the right arm of the third pair is hectocotylized, its terminal portion being changed into a spoon-shaped organ, smooth on the outer convex side and furnished with a series of transverse ridges on the inner concave side, and with a basal angular lobe from which a groove or furrow extends along the lower margin of the arm to the basal web. In some species of *Octopus* this modified tip is very small, but in others very large.

The female has oviducts on both sides. Eggs comparatively few

and large, elongated pyriform, attached singly or in clusters by the small end.

In addition to the several small species described here, a much larger rough-backed species has been taken several times at Fort Macon and near Beaufort, N. C. This is probably *Octopus rugosus* Bosc, a West Indian species.

Octopus Bairdii Verrill.

Octopus Bairdii Verrill, Amer. Jour. Sci., v, p. 5, Jan., 1873; xix, p. 294, 1880; American Naturalist, vii, p. 394, figs. 76, 77, 1873; Am. Assoc. Adv. Sci. for 1873, p. 348, pl. 1, figs. 1, 2, 1874.

G. O. Sars, Mollusca Regionis Arcticæ Norvegiæ, p. 339, pl. 33, figs. 1–10 (♀), pl. xvii, figs. 8*a* to 8*d* (dentition and jaws), 1878.

Tyron, Man. Conch., i, p. 116, pl. 32, figs. 37, 38 (description and figures from the papers by A. E. V.).

Verrill, Bulletin Mus. Comp. Zool., viii, p. 107, pl. 2, figs. 4, 4*a*; pl. 4, figs. 1, 1*a*, 1881.

Plate XXXIII, figs. 1, 1*a*. Plate XXXIV, figs. 5, 6. Plate XXXVI, fig. 10. Plate XXXVIII, fig. 8; Plate XLIX, figs. 4, 4*a*; Plate LI, figs. 1, 1*a*.

The body is short, thick, somewhat depressed, broadly rounded posteriorly, separated from the head only by a slight constriction at the sides. Head almost as broad as the body, swollen above and around the eyes, concave in the middle above; around the eyes, and especially in front and above, there are numerous small conical, often irregular and rough tubercles; a little removed from the upper side of each eye, is a much larger, rough, irregularly conical, erectile cirrus, which has some small, more or less prominent, conical papillæ on its surface; the whole upper surface of the body, head, and arms is also covered with minute scattered papillæ, which are usually but little prominent, but in some of the larger males they become much larger and more numerous, and have the form of small prominent warts.

The jaws (Plate XLIX, fig. 4*a*) have rather blunt, slightly incurved tips, with the angle at the bases of the cutting edges round and without any distinct notch. The odontophore, (Plate XLIX, fig. 4) has a median row of large, acute teeth, with broad bases without lateral denticles; the inner lateral teeth are much smaller, with curved acute-triangular points; outer lateral teeth longer and more acute; marginal plates large and distinct.

Siphon large, tapering, capable of being bent in all directions, so as to be used for swimming either forward, backward, or sideways, according to its direction.

Arms subequal, relatively short, stout, tapering to slender points, connected for about one-third of their length by a web, which extends as a narrow membrane along their margins to near the ends. Suckers small, not crowded, alternating pretty regularly in two rows; in the original type-specimen, which was not full grown, the arms of the first pair each had about sixty-five suckers; those of the fourth pair about sixty. In a large example (♀) the dorsal arms have about 94; third pair about 100; fourth pair about 90.

In the male, the right arm of the third pair has its terminal portion, for about a third of its entire length, modified for reproductive purposes into a large spoon-shaped organ (Plate XXXIII, figs. 1, 1*a*, *b*), broadly elliptical in outline, with the sides incurved and the end somewhat tri-lobed; its interior deeply concave with ten to twelve, and occasionally, in the largest examples, thirteen, elevated transverse folds; at the base, there is a fold bent into an acute angle, the apex directed forward, leaving a deep V-shaped sinus behind it, which is a continuation of a shallow groove formed by a thickening of the web along the lower side of the arm, and terminating midway between it and the fourth arm. At the end, this arm terminates in a small conical tip, between the two broadly rounded lobes of the spoon-shaped organ; at the base of this organ there is a slight constriction; the basal portion of the arm bears 30 to 37 suckers, like those on the other arms. The modified portion of the arm is considerably longer than the distance between the constriction at its base and the interbrachial web, and about equal to one-half the total length of the part which bears suckers. The corresponding arm on the left side is of the ordinary form and has, in a medium sized example, about fifty-one suckers. The female differs but little from the male, externally, except in lacking the modification of the third right arm.

Length of the original male specimen, in alcohol, exclusive of the arms, 44^{mm}; breadth of the body, 31^{mm}; between eyes, 18^{mm}; length of the arms, of the first pair, from mouth, 18^{mm}; from mouth to edge of the web, 57^{mm}; length of modified portion of third right arm, 18^{mm}; breadth of this organ when expanded, 11·5^{mm}. Subsequently somewhat larger specimens, both male and female, have been taken.

One of the largest males (Station 878) measures from tip of dorsal arms to end of body, 163^{mm}; from edge of dorsal web to end of body, 75^{mm}; from edge of mantle, beneath, to end of body, 38; breadth of body, 48; of head, 41; length of dorsal arms to beak, 110; of second pair, 112; of third pair, 115; of fourth pair, 110; of hectocotylized arm, 85; length of terminal spoon, 33; its breadth, 17. This specimen has thirteen transverse lamellæ in the spoon.

One of the largest females (Station 895,) in breeding season and filled with eggs, measures, from tip of dorsal arms to end of body, 170[mm]; edge of dorsal web to end of body, 90; mantle, beneath, 46; breadth of body, 55; of head, 41; length of dorsal arms from beak, 125; of second pair, 120; of third pair, 115; of fourth pair, 115[mm].

When living, the ground-color was usually pale, translucent, bluish white, above thickly specked with light orange-brown and dark purplish brown. Its colors were changeable, but apparently less actively so than in the squids.

The spermatophores (Pl. XXVI, fig. 10, A, B) are remarkably large in proportion to the size of the animal, being from 50 to 75[mm] in length and 4 to 5[mm] in diameter. The form is club-shaped, with the narrow portion little longer than the thickened part. They are almost perfectly transparent, and the milk-white, coiled string of spermatozoa can be plainly seen in the interior. There is a slender, thread-like filament at each end, that of the small end much the longest. When they begin to discharge their contents (as in fig. 10, A), the form changes rapidly. In several instances I have observed these spermatophores escaping from the siphon of recently captured specimens, taken at various dates, from July 23 to Sept. 21, at stations 138, 161, 163, 223, etc.

This species was first discovered by the writer, while dredging in 1872, on the U. S. steamer "Mosswood," in the Bay of Fundy, off Eastport, Me., in 75 to 80 fathoms. Although so recently discovered, it proves to have a very extensive range, both geographically and in depth. It is one of the most common and characteristic inhabitants of the bottom, in 100 to 500 fathoms, along our entire coast, from South Carolina to Newfoundland. It was taken in the trawl, by the U. S. Fish Commission, in 1872, 1873, 1874, 1877, 1878, 1879, and 1880, in depths ranging from 50 to 500 fathoms, at numerous localities, from off Halifax, N. S., and in the Bay of Fundy, to the region 90 to 100 miles south of Newport, R. I., where it is common and of large size. It was obtained by Mr. A. Agassiz, on the "Blake," in 1880, at various stations, from N. lat. 41° 34′ 30″, to 32° 43′ 25″, in 178 to 524 fathoms.

In November, 1880, it was taken by Lieut. Z. L. Tanner, on the "Fish Hawk," off the mouth of Chesapeake Bay, in 157 to 300 fathoms.

The Gloucester fishermen have brought in several specimens from the banks off Nova Scotia and Newfoundland.

Professor G. O. Sars has taken it off the Norwegian coast, in 60 to 300 fathoms.

It occurs both on soft muddy bottoms and on hard bottoms. Both sexes often occur together, but the males are usually the most numerous.

Recently hatched young have been taken in August and September, in the Bay of Fundy, off Halifax, N. S., and off Cape Ann, Mass. (at stations 45, 85, 234, 238, etc.).

One of the specimens obtained by Mr. Agassiz is remarkable for the length and slenderness of the cirrus above the eyes (Plate LI, fig. 1, 1*a*). This is an immature male, and does not appear to differ in any other way from ordinary specimens, of similar size. The appendage of the hectocotylized arm is small and not fully developed (as is always the case in young males), and has an ovate-triangular form, a slightly concave surface, and only a few transverse lamellæ.

Octopus Bairdii.—Specimens examined.

Stat.	Locality.	Fath.	Bottom.	When coll'd.	Specimens. No. Sex.
	U. S. Fish Com.				
	Bay of Fundy	75	----	1872	2 ♂ : 1 j. ♀
	Bay of Fundy	80	----	1872	1 l. ♂
	Bay of Fundy	60	----	1872	1 ♂
	Off G. Menan I.	97–110	gravel	1872	2 j. ♂
	Casco Bay	64	----	1873	1 med.
				1877	
30,31,					2 l. ♂ : 2 juv.
32, 33	Gulf of Maine, off Cape Ann	90	mud	Aug. 14	5 ♂
45	Off Cape Sable, 30 m.	91	fine sand	Aug. 21	1 l. ♂ : 4 j. ♂ : 4 j. ♀
85, 86	Off Halifax, 23 m.	101	fine sand	Sept. 6	2 ♂ : 2 l. ♂ : 4 ♀
	Gulf Maine and Mass. Bay.				
	Off Gloucester, Mass.			1878	
130	S. of Cape Ann, 13 m.	49	mud	July 23	1 ♂
138	Off Cape Ann, 9 m.	59	muddy	July 29	1 j. ♂ : 2 l. ♂ : 2 ♀
156	Off Cape Ann, 5½ m.	42	mud	Aug. 15	1 j.
161	Off Cape Ann, 6 m.	54	sand	Aug. 16	1 l. ♂ : 1 j. ♂ : 1 j. ♀
163	Off Cape Ann, 6½ m.	73	fine sand	Aug. 16	5 j. ♂ : 3 l. ♂ : 1 j. ♀
164	Off Cape Ann, 7 m.	75	fine sand	Aug. 16	2 ♂ : 3 j. ♂ : 2 l. ♀ : 3
182	South of Gloucester	45	----	Aug. 29	4 j. ♀ [j. ♀
199	Off Cape Ann, 13½ m.	58	muddy	Sept. 2	1 j. ♂ : 2 l. ♂ : 1 l. ♀ : 2
184	Off Gloucester, Mass., 4½ m.	45	mud	Aug. 29	3 j. ♀ : 1 j. ♂ [j. ♀
207	Off Gloucester, Mass., 4¾ m.	42	soft mud	Sept. 16	1 j. ♂
211	Off Cape Ann, 6 m.	60	mud	Sept. 17	4 j. ♂ : 2 j. ♀ : 1 ♀
213	Off Cape Ann, 5½ m.	68	mud	Sept. 17	1 l. ♂
214	Off Cape Ann, 6 m.	57	fine sand	Sept. 17	1 m. ♀
223	Off Cape Ann, 7 m.	47	soft mud	Sept. 21	2 ♂ : 1 ♀ : 1 l. ♀
233	South of Gloucester, 4¾ m.	45	soft mud	Sept. 24	1 j. ♂
234	South of Gloucester	43	soft mud	Sept. 24	2 j. ♂ : 1 j. ♀
238	Off Gloucester, 4½ m.	43	soft mud	Sept. 26	2 ♀

Octopus Bairdii—Continued.

Stat.	Locality.	Fath.	Bottom.	When coll'd.	Specimens. No. Sex.
				1879	
264	Off Cape Cod, 15 m.	80	mud	July 29	2 j. ♂ : 1 l. ♀ : 1 j. ♀
342	Off Cape Cod, 14 m.	94	mud	Sept. 10	2 m. ♂ : 1 j. ♀
364	Off Cape Cod, 15 m.	70	hard sand	Sept. 18	3 l. ♂ : 2 j. ♂ : 2 l. ♀
372	Off Chatham, Mass., 21 m.	70	sand	Sept. 19	1 l. ♀
	Off Newport, R. I.				
	N. Lat. W. Long.			1880	
869	40° 02′ 18″; 70° 23′ 06″	192	mud, fine sand	Sept. 4	1 l. ♀ : 3 j. ♀
870	40 02 36; 70 22 58	155	fine sand	Sept. 4	1 l. ♂ : 3 j.
874	40 ; 70 57	85	mud	Sept. 13	1
878	39 55 ; 70 54 15	142½	mud	Sept. 13	1 l. ♂
879	39 49 30; 70 54	225	fine sand	Sept. 13	1 ♂ : 1 ♀
880	39 48 30; 70 54	252½	mud	Sept. 13	1 ♂ : 1 ♀
892	39 46 ; 71 05	487	mud	Oct. 2	1 l. ♀
893	39 52 20; 70 58	372	mud	Oct. 2	2 ♂ : 2 ♀
894	39 53 ; 70 58 30	365	sand	Oct. 2	3 l. ♂ : 3 ♀
895	39 56 30; 70 59 45	238	mud	Oct. 2	2 ♂ : 2 ♀
	Off Chesapeake Bay.				
897	37 25 ; 74 18	157½	sand	Nov. 16	1 ♂
898	37 24 ; 74 17	300	mud	Nov. 16	2 ♂ : 4 ♀
	Blake Exp.—U. S. Coast Survey.				
	N. Lat. W. Long.				
303	41° 34′ 30″; 65° 54′ 30″	306	----	1880	1 ♂ (fig'd)
332	35 45 30; 74 48	263	----	1880	4 ♂ : 1 j. ♀
327	34 0 30; 76 10 30	178	----	1880	1 ♂ : 1 ♀
310	39 59 16; 70 18 30	260	----	1880	1 ♂
336	38 21 50; 73 32	197	----	1880	1 ♂ j.
321	32 43 25; 77 20 30	233	----	1880	1 ♂ : 1 ♀ j.
306	41 32 50; 65 55	524	----	1880	1 ♂ j.
Lot.	*Gloucester Fisheries.*		*Schooner.*		
264	Lat. 42° 49′; long. 62° 57′	200–300	Marion	Jan. '79	1 l. ♀
351	N. lat. 44° 17′; W. long. 58° 10′	120	Grace L. Fears	June '79	2 ♀
372	Off Miquelon I.	7	A. M. Williams	July '79	1
421	Banquereau, off N. S.	300	Commonw'lth	Aug. '79	1 ♀
501	N. lat. 43° 14′; long. 61° 7′	250	A. M. Williams	Oct. '79	1 ♀
605	Brown's Bank, N. S.	---	Barracouta	Jan. '80	1 mutilated
771	Off St. Peter's Bank	80	Epes Tarr	July '80	1 ♂ : 1 ♀
792		---	G. P. Whitman	Aug. '80	1 l. ♂
917	Banquereau, N. S.	---	A. M. Williams	1880	1 l. ♂
721	Grand Bank	---	Guyot Cunningham	July '80	1 l. ♀

In the last column, *j.* = young; *l.* = large; *m.* or *med.* = medium size.

Specimens of this species were kept alive for several days, in order to observe its habits. Several characteristic drawings, three of which are now reproduced (Plate XXXIV, figs. 5, 6; Plate XXXVIII, fig. 8), were made from life by Mr. J. H. Emerton, showing its different attitudes.

When at rest it remained at the bottom of the vessel, adhering firmly by some of the basal suckers of its arms, while the outer portions of the arms were curled back in various positions; the body was held in a nearly horizontal position, and the eyes were usually half-closed and had a sleepy look; the siphon was usually turned to one side, and was long enough to be seen in a view from above.

When disturbed, or in any way excited, the eyes opened more widely, especially at night; the body became more contracted and rounded, and was held more erect; the small tubercles over its surface and the larger ones above the eyes were erected, giving it a very decided appearance of excitement and watchfulness.

It was rarely, if ever, observed actually to creep about by means of its arms and suckers, but it would swim readily and actively, circling around the pans or jars, in which it was kept, many times before resting again.

In swimming backward the partial web connecting the arms together was used as an organ of locomotion, as well as the siphon; the arms and web were alternately spread and closed, the closing being done energetically and coincidently with the ejection of the water from the siphon, and the arms after each contraction were all held pointing straight forward in a compact bundle, so as to afford the least resistance to the motion (fig. 8). As the motion resulting from each impulse began to diminish sensibly, the arms were again spread, and the same actions repeated. This use of the arms and web recalled that of the disk of the jelly-fishes, but it was much more energetic.

The siphon was bent in different directions to alter the direction of the motions, and by bending it to the right or left side, backward motions in oblique or circular directions were given, but it was often bent directly downward and curved backward, so that the jet of water from it served to propel the animal directly forward. This, so far as observed, was its only mode of moving forward. The same mode of swimming forward has been observed in cuttle-fishes (*Sepia*) and in squids (*Loligo*).

This species was much more active and animated in the night than during the day, and is probably largely nocturnal in its habits, when at liberty. None of the specimens could be induced to take food, and none survived more than four or five days, although the water was frequently renewed to keep it cool and pure. They had been rather roughly handled by the dredges and trawls, without doubt. But the unavoidable exposure to the higher temperature of the water, near and

Measurements of northern species of Octopus (in inches).

Name.	*O. piscatorum* ♀.		*O. lentus* ♀.		*O. obesus* ♂.		*O. Bairdii.*		
Right or left side.	Left.	Right.	Left.	Right.	Left.	Right.	♂.	♂.	♀.
Total length, to tip of arms, 1st pair	6·20	5·80	7·48	7·76	7·90	8·50	2·50	6·25	7·00
Total length, to tip of arms, 2d pair	6·30	5·00	7·12	7·40	7·98	7·98	2·40	6·20	6·50
Total length, to tip of arms, 3d pair	5·75	5·30	7·52	7·76	7·86	6 90	2·45	5·50	6·40
Total length, to tip of arms, 4th pair	5·25	5·00	7·16	6·94	7·10	7·46	2·50	5·25	6·25
Length to web between dorsal arms	3·25	--	--	--	4·40	--	1·35	3·96	2·55
Length to edge of mantle (beneath)	1·20	--	2·40	--	1·96	--	--	1·50	1·82
Length to center of eye	1·55	--	--	--	2·88	-	--	1·50	2·00
Breadth of body, in middle	1·25	--	1·60	--	1·84	--	·95	1·90	2·17
Breadth of head (across eyes)	1·20	--	1·28	--	1·52	--	·85	1·62	1·62
Breadth of arms, near base	·22	--	·30	--	·32	--	--	·28	·35
From beak to web, between dorsal arms	1·10	--	--	--	--	--	--	1·00	1·35
Length of spoon of hectocotylized arm	--	--	--	--	--	1·40	·30	1·30	--
Its breadth	--	--	--	--	--	·64	·15	·68	--
Rest of arm, to beak	--	--	--	--	--	2·60	--	2·25	--
Length of dorsal arms, from beak	4·25	4·00	4·20	4·48	--	--	--	4·25	4·95
Length of 2d pair arms, from beak	4·35	3·20	3·84	4·12	--	--	--	4·35	4·60
Length of 3d pair arms, from beak	3·85	3·75	4·24	4·48	--	--	--	4·00	4·35
Length of 4th pair arms, from beak	3·15	3·20	3·88	3·76	--	--	--	3·85	4·15

at the surface, especially in summer, is sufficient to kill many of the deep-water animals, while others that live for a short time never recover entirely.

This species resembles *O. lentus*, but has a much larger and rough or lacerate cirrus above the eye. The modified arm of the male is also different. It is somewhat related to *O. Grœnlandicus* Dewh., but the male of the latter has the third right arm much longer, with the modified spoon-shaped portion relatively very much smaller and quite different in form, and with more numerous folds, and the basal part bears 41 to 43 suckers; the other arms also have more numerous suckers; the web is less extensive and the body is more elongated and appears to be smooth and destitute of the large cirrus above the eyes, if correctly figured.

O. obesus has the spoon-shaped part of the third right arm relatively larger, and several of the basal suckers of the other arms are in a single row. It also differs in other respects.

Octopus lentus Verrill.

Verrill, Amer. Jour. Sci., xix, p. 138, Feb., 1880: p. 294, April, 1880; Bulletin Mus. Comp. Zool., viii, p. 108, pl. 4, fig. 2, ♂.

PLATE XXXV, FIGURES 1, 2, ♀. PLATE LI, FIGURE 2, ♂.

Female (type specimen): Body broad, stout, depressed, slightly emarginate at the posterior end, rather soft to the touch, and in some specimens gelatinous in appearance; a thin, soft, free, marginal membrane runs along the sides and around the posterior end of the body, becoming widest (about 12^{mm}) posteriorly; in some of the more strongly contracted specimens this membrane is but little apparent. Head large, broad, depressed, with the eyes large and far apart; above each eye there is a small, simple, conical, acute, contractile cirrus. A well-developed thin web connects the arms, considerably above their bases, and then runs up to the tips as broad margins to each arm.

The arms are rather large, stout at base, with a broad inner face, and taper gradually to very slender tips; the first and third pairs are nearly equal in length; those of the second are also about equal in length to the fourth pair, but are somewhat shorter than the first and third. The arms on the right side, in the type-specimen, were all somewhat longer than the corresponding ones on the left. The arms, measuring from the beak, are more than twice as long as the body. The suckers are arranged in two distinct rows, to the base.

Color of head and body above, and of body beneath, deep reddish

brown, closely specked with darker brown, and with many small roundish spots of whitish on the body and arms.

Length of the type-specimen (♀) from the beak to the end of the body, not including the marginal web, 60^{mm}; breadth of web, 22; total length, 194; breadth of body, 40; breadth of head, across eyes, 32; of eye-openings, 10; of eye-balls, 17; length of mantle, beneath, 38; length of arms of first pair, 112 and 105; of second pair, 103 and 96; of third pair, 112 and 106; of fourth pair 94 and 97; breadth of those of the three upper pairs, 8; of the ventral pair, 7^{mm}.

Male: Body depressed, rounded posteriorly, with only a trace of the lateral and posterior fold; surface soft and nearly smooth, but showing a small number of minute white papillæ sparsely scattered over the dorsal surface. Cirrus above the eye small and simple, usually contracted into a small, wart-like papilla. Head broad and flattened; eyes large. Arms rather long and slender, with slender tapering tips, their bases united by a rather wide web. Suckers small, very prominent, forming two regular rows, quite to the base.

The first two pairs of arms are nearly equal and somewhat longer than the two lower pairs, which differ but little between themselves. The hectocotylized arm (third of right side) bears thirty-five suckers, in two rows, and a remarkably large, terminal spoon-shaped organ, which occupies more than a third of the total length of the arm; its sides are bent up and the edges inrolled, so as to form a deep cavity; its outer end is broadly rounded laterally, and terminates in a central, narrow, acute lobe; internally there are nine large, high, oblique lamellæ, with deep fossæ between them; the proximal end has a large, acute, triangular lobe, with involute margins; from this lobe a broad groove runs along the lower edge of the arm to the margin of the web; where it terminates there is a distinct thickening of the bounding membrane.

The two males of this species, described above, were dredged by Mr. A. Agassiz, on the "Blake," in 1880, in 464 and 603 fathoms. They agree well in the peculiar characters and large size of the appendage of the hectocotylized arm. The females, only, were previously known. Although these males have a mere trace of the loose membranous fold of skin, along the sides and around the posterior end, so conspicuous in the original female specimen of this species, they agree so well in other characters that I unite them without much hesitation. It is probable that the presence or absence of the membranous fold, in this and other species, may be due merely to differences in the state of contraction when they die, or even to differences in the strength of the alcohol.

Measurements in millimeters.

	♂ Right Side.	♂ Left Side.	♀ Right Side.	♀ Left Side.
Total length	95	--	194	--
Posterior end to center of eye	34	--	--	--
Eye to tip of dorsal arms	64	--	--	--
Breadth of body	28	--	40	--
Breadth of head	22	--	32	--
Length of dorsal arms, from mouth	65	61	112	105
" second pair "	61	--	103	96
" third " "	--	52	112	106
" hectocotylized arm, from mouth	58	--	--	--
" fourth pair	--	53	94	97
" spoon-shaped appendage	23	--	--	--
Breadth of the same	16	--	--	--

The first specimen of this species was taken off Nova Scotia, near Le Have Bank, in 120 fathoms, by Captain Samuel Peeples and crew of the schooner "M. H. Perkins," and presented to the U. S. Fish Commission. A few others have since been brought in by the Gloucester fishermen, from the Bank Fisheries. Mr. A. Agassiz, dredged it on the "Blake," in 1880, as far south as N. lat. 33° 42′ 15″. It ranges in depth from 120 to 602 fathoms.

Specimens examined.

No.	Stat.	Locality.	Fath.	When coll'd.	Specimens. No. and Sex.
7	326	N. Lat. 33° 42′ 15″; W. Long. 76° 0′ 50″ (Blake)	464	1879	1 ♂: 1 ♀
10	329	N. Lat. 34° 39′ 40″; W. Long. 75° 14′ 40″ (Blake)	603	1879	1 ♂ (fig'd.)
	553	Le Have Bank, N. S. (sch. M. H. Perkins)	120	1879	1 ♀ (fig'd.)
	718	S. of Newfoundland (sch. Proctor Brothers)	150	Jn '80	1 sm. ♀
	737	St. Peter's Bank (sch. Augusta H. Johnson)	200	1880	1 l. ♀
	807	Banquereau (sch. Epes Tarr)		Au. '80	1 ♀
	808	N. Lat. 44° 32′; Gr. Bank (sch. Guy Cunningham)		Au. '80	1 ♀

In the soft consistency of the flesh and skin, this species resembles *O. obesus*. It differs in the shorter and posteriorly emarginate body, and especially in the arrangement of the suckers, which, in that species, are in a single series toward the bases of the arms.

Octopus piscatorum Verrill.

Verrill, Amer. Jour. Sci., vol. xviii, p. 470, Dec., 1879; xix, p. 294, Apr., 1880.

Plate XXXVI, figures 1, 2, ♀.

The body of the female is smooth, depressed, about as broad as long; rounded posteriorly, not showing any lateral ridges, nor dorsal papillæ; a small simple papilla above the eyes. Arms long, rather slender, tapering to long, slender, acute tips, the upper ones a little (2·5^{mm}) shorter than those of the second pair, which are the longest;

those of the third pair are about 12^{mm} shorter than those of the second; the ventral pair about 6^{mm} shorter than those of the third. In our type-specimen, all the arms on the right side are somewhat shorter than those on the left, and the web between the first and second arms is narrower, due, perhaps, to recovery from an injury. The web between the arms, except ventrally, is of about equal width, and scarcely more than one-fourth the length of the arms, measuring from the beak. Between the ventral arms the web is about half as wide as between the lateral.

The suckers are moderately large, decidedly prominent, alternating in two regular rows, except close to the mouth, where a few stand nearly in a single line; about fourteen to sixteen are situated on the part of the arms included within the interbrachial web. The whole number of suckers on one arm is upwards of seventy.

Color of one alcoholic specimen is deep purplish brown, due to very numerous crowded minute specks; eye-lids, whitish. The front border of the mantle, beneath, and the base of the siphon and adjacent parts are white; end of siphon, brown. Lower side of head and arms lighter than the dorsal side.

Total length, from posterior end of body to tip of arms, of 1st pair, 158^{mm}; 2d pair, 160^{mm}; 3d pair, 146^{mm}; 4th pair, 133^{mm}; to web between dorsal arms, 82^{mm}; between ventral arms, 63^{mm}; to edge of mantle, beneath, 30^{mm}; to center of eye, 39^{mm}. Breadth of body, 31^{mm}; of head across eyes, 30^{mm}; breadth of arms, at base, 5·5^{mm}; diameter of largest suckers, 2·5^{mm}; length of arms beyond web, 1st pair, 76^{mm}; 2d pair, 82^{mm}; 3d pair, 71^{mm}; 4th pair, 69^{mm}.

Two specimens of this species, both females, have been obtained. The first was from Le Have Bank, off Nova Scotia, in 120 fathoms, taken by Captain John McInnis and crew, of the schooner "M. H. Perkins," October, 1879; the second was taken by Captain David Campbell and crew, of the schooner "Admiral," (lot 590), near the Grand Bank, N. lat. 44° 07′; W. long. 52° 40′, in 200 fathoms, December, 1879.

This species resembles *O. Grönlandicus*, of which only the males appear to have been described, and it may eventually prove to be the female of that species.

This species is easily distinguished from *O. Bairdii*, by its more elongated body, its much longer and more slender and tapered arms, with shorter webs; by the absence of the large, rough, pointed papilla, or cirrus, above the eye, and by its general smoothness. The white color of the underside of the neck, siphon and mantle-border also appears to be characteristic.

Octopus obesus Verrill.

Verrill, American Jour. Sci., vol. xix, p. 137, Feb., 1880; vol. xix, p. 294, Apr., 1880.

Plate XXXVI. figures 3, 3*a*, 3*b*.

Male: Remarkable for the great size of the spoon-shaped organ of the right arm of the third pair. Body relatively large, stout, oblong-oval, somewhat flattened above, obtusely rounded at the posterior end; soft and somewhat gelatinous in texture; skin, so far as preserved, smooth, soft. No cirrus exists above the eye, in our specimen, but the skin is not so well preserved in that region as to render it certain that a small one may not have existed in life. Eyes very large.

Arms moderately long, the dorsal longest, others successively shorter; all somewhat laterally compressed at base, tapering to long, slender tips; a moderately developed web connects them together at base. The hectocotylized arm (third of right side), bears at the end a very large, broad and thick, but not very deep, spoon-like organ, occupying more than a third of the total length of the arm; its inner surface is crossed by eleven oblique, thick, rounded folds or ribs, ten of them converging backward to the median line and at their outer ends joining a marginal thickening. The distal end terminates in a median, pointed lobe, or tip, with a thin, rounded, lateral lobe each side of it; the proximal border is formed by the last (eleventh) fold, which is V-shaped, with the apex pointing distally. A broad, thin, marginal membrane extends along the lower side of the arm, from the terminal organ to the base. The suckers have been partly detached from this arm.

The suckers of all the arms are moderately large, nearly globular in form, rather numerous; the first six to ten, at the base, are nearly in one line, except on the left arm of the second pair, and appear to form only a single row; in this part the inner face of the arm is narrow, most so on the right arm of the second pair, and least on the left arm of the same pair; farther out this face becomes broader and the suckers are in two distinct rows. The suckers are destroyed on the distal portion of all the arms.

The color of the body and arms is mostly destroyed, but so far as preserved, is pale pinkish, more or less thickly specked with distinct reddish brown spots, most conspicuous at the base of the arms and above the eyes, (elsewhere the color is probably not so well preserved).

Length of body, from the posterior end to the base of arms, 82^{mm}; to center of eye, 72; to edge of mantle, beneath, 49; to tip of right

dorsal arm, 213; left, 198; to tips of second pair, 200; to tip of right arm of third pair, 173; of left, 197; to tip of right, of fourth pair, 187; of left, 178; to edge of web, 110; breadth of body, in middle, 46; breadth of head, across eyes, 38; breadth of dorsal arms, at base, 8; diameter of largest suckers, 3; length of spoon-shaped end of right arm of third pair (hectocotylized), 35; breadth, 16; length of rest of arm, to mouth, 65mm.

Taken from the stomach of a halibut, 36 miles east from the N. E. Light of Sable Island, in 160 to 300 fathoms, by Charles Ruckley, of the schooner "H. A. Duncan," and presented by him to the U. S. Fish Commission, 1879. A smaller, mutilated specimen was also taken from the stomach of a halibut, from Banquereau, off N. S., in 150 fathoms (lot 678), and presented to the U. S. Fish Commission, by Captain Charles Markuson and crew, of the schooner "Notice," April, 1880. The latter specimen was, however, in too poor condition to afford any additional characters, and may, perhaps, belong to *O. lentus*.

This species differs from *Octopus Bairdii* V., *O. lentus* V. and *O. piscatorum* V., from the same region, in its longer and larger body, and especially in having the basal suckers in a single row. The 'spoon' of the hectocotylized arm is very much larger than in *O. Grönlandicus*, and considerably larger and flatter and more deeply trilobed at the end than in *O. Bairdii*.

Eledone Leach.

Octopus (*pars*) Lamarck; Cuvier; Blainville, etc.

Eledone Leach, Zool. Misc., iii, 137, 1817 (t. Gray); D'Orbig. Céphal. Acétab., p. 72 (subgenus); Gray, Catal. Moll. Brit. Mus., i, p. 21, 1849.

Body, mantle, and siphon as in *Octopus*. Suckers in a single row on all the arms. In the male the right arm of the third pair is hectocotylized by the formation of a small spoon-shaped tip and a lateral groove, nearly as in some species of *Octopus*.

Eledone verrucosa Verrill.

Bulletin Mus. Comp. Zool., viii, p. 105, pl. 5, 6, March, 1881.

Plates LII, LIII.

A stout species, covered above with prominent, rough, wart-like tubercles, and with a circle of the same around the eyes; four or five of those above the eyes are larger and more prominent. Body thick, broad-ovate, swollen beneath, moderately convex above, obtusely rounded posteriorly.

Male: Head as broad as the body, whole upper surface of body and head to base of arms covered with prominent and persistent, unequal warts, which are roughened by sharp, conical papillæ, eight or ten on the larger warts, but only two or three on the smaller ones; the warts diminish in size anteriorly, and on the sides, before they disappear; around the eyes they form irregular circles; just above each of the eyes there are two much larger ones, bearing more than twenty conical papillæ; there is one before and one behind these, of somewhat smaller size. Eyes large, the lower lid purple and thickened, overlapping the upper one, which is thin and whitish.

Arms considerably longer than the head and body, not very stout, compressed, bearing a single crowded row of large whitish suckers, which are mostly separated by spaces less than half their diameter; margins of suckers soft and much thickened. The three lower pairs of arms are very nearly equal in length and size; the dorsal ones are a little shorter and smaller. A thin web unites all the arms for about one-fourth of their length, and runs up along their sides for about half their length. The male has the third right arm (Plate LII, fig. 1, 1*a*) hectocotylized at the tip; the modified tip is preceded by forty-five suckers, and is bordered ventrally by a broad membrane, having a white groove along its inner surface; the terminal organ (fig. 1*a*) consists of a small, ovate-triangular, fleshy disk, with its inner surface slightly concave and finely wrinkled transversely, and terminating proximally in a small point.

Color dark purplish brown, darker purple beneath. Chromatophores small and densely crowded.

The female is considerably larger than the male, and has the warts over the back and around the eyes relatively smaller, but of the same character. The arms appear to be larger than those of the male, but this is probably due to the fact that the male has become more contracted by the stronger alcohol in which it was placed.

This female specimen illustrates well the uselessness of the attempts to divide the species of *Octopus* and allied genera into groups or sections, according to the relative length of the arms, as J. E. Gray and others have done, for in this and many other cases the proportions of the arms of the right side would throw it into one section; those of the left side into another. The male would have to be put into a third section.

The two known examples of this species were taken by Mr. A. Agassiz, while dredging on the United States Coast Survey steamer "Blake," in 1880.

Measurements in millimeters.

	No. 12. ♂	No. 13. ♀ Right Side.	Left Side.
Total length	202·	360·	
End of body to center of eye	58·	100·	
Breadth of body	55·	65·	
Breadth across eyes	49·		
Length of dorsal arms, from mouth	135·	255·	260·
Length of second pair of arms	155·	260·	235·
Length of third pair of arms		225·	240·
Length of hectocotylized arm	130·		
Length of modified tip	4·5		
Length of ventral arms	145·	210·	225·
Greatest breadth of lateral arms	12·	18·	18·
Diameter of largest suckers	3·	5·	5·

Specimens examined.

No.	Stat.	Locality.	Fath.	When rec'd.	Specimens. No.	Sex.
12	305	N. Lat. 41° 33′ 15″; W. Long. 65° 51′ 25″	810	1880	1	♂
13	312	N. Lat. 39° 50′ 45″; W. Long. 70° 11′	466	1880	1	♀

Family CIRRHOTEUTHIDÆ Keff.

Kefferstein, in Bronn, Thier-Reich, iii, p. 1448, 1866.

Body somewhat elongated, furnished with a short, thick tapering fin on each side, supported by an internal transverse cartilage. Mantle extensively united to the head. No connective cartilages. Arms united together nearly to the tips by a broad umbrella-shaped membrane or web. Suckers in a single row, alternating with slender cirri.

Stauroteuthis Verrill.

Verrill, American Journal of Science, vol. xviii, p. 468, Dec., 1879.

Allied to *Cirrhoteuthis*, but with the mantle united to the head all around, and to the dorsal side of the slender siphon, which it surrounds like a close collar, leaving only a very narrow opening around the base of the siphon, laterally and ventrally. Fins long-triangular, in advance of the middle of the body. Dorsal cartilage forming a median angle, directed backward. Body flattened, soft, bordered by a membrane. Eyes covered by the integument. Web not reaching the tips of the arms, the edge concave in the intervals. Suckers in one row, with a pair of slender cirri alternating with them along most of the arm. Cirri absent between the basal and terminal suckers.

Stauroteuthis syrtensis Verrill.

Amer. Jour. Sci., vol. xviii, p. 468, Dec., 1879; xix, p. 294, pl. xvi, Apr., 1880.

Plate XXXII, figures 1–5.

Female: Head broad, depressed, not very distinct from the body. Eyes large. Body elongated, flattened, soft or gelatinous, widest in

the middle, narrowed but little forward, but decidedly tapered, back of the fins, to the flat, obtuse, or subtruncate tail. The sides of the head and of the body, forward of the fins, are bordered by a thin soft membrane, about 12mm wide. The fins are elongated, sub-triangular, obtusely pointed, placed in advance of the middle of the body; supported by internal cartilages, which unite with a transverse dorsal V-shaped one, situated behind the fins. Siphon elongated (about 12mm), slender, round, with a small terminal opening. Mantle edge is contracted and thickened around the base of the siphon so as to show only a very small opening, and is united to its anterior or dorsal commissural band. Eyes large, distinctly visible through the integument. Arms long, slender, sub-equal, each united to the great web by a broad membrane developed on its outer side, widest (about 38mm or 1·5 inches) in the middle of the arm, while the edge of the web unites directly to the sides of the arms and runs along the free portion toward the very slender tip, as a border. This arrangement gives a swollen or campanulate form to the extended web. Edges of the web incurved between the arms, widest between the two lateral pairs of arms. The arms bear each fifty-five or more suckers, in a single row. Those in the middle region are wide-apart (12mm or more), with a pair of slender, thread-like cirri, about 25 to 32mm long, midway between them. The cirri commence, in a rudimentary form, between the 5th and 6th suckers, on the dorsal arms, and between the 7th and 8th, on the lateral and ventral ones. They cease before the 23d sucker on the dorsal and lateral arms, and before the 22d on the ventral ones, which bear each 14 pairs of cirri. Near the mouth, and beyond the last cirri, on the free portion of the arms, the suckers are more closely arranged. The jaws are small, with a deep cavity. Beyond the last cirri, on the dorsal arms, there are 33 to 35 small suckers. The 2d arm on the right side appears to be imperfect. On this arm there are but 19 suckers beyond the last cirri; then follow minute, wart-like tubercles, extending to the tip. Color, in alcohol, generally pale with irregular mottlings and streaks of dull brownish; inner surface of arms and web, toward the base, and membrane around the mouth, deep purplish brown. Length from end of body to base of arms, 160mm; length to posterior base of fins, 63mm; to anterior base, 101mm; width across fins, 126mm; in advance of fins, 53mm (not including lateral membrane); across eyes, 44mm; across end of tail, 30mm; diameter of eye, 25mm; width of fins, at base, 33mm; their length, 44mm; length of arms, 330mm to 355mm; portion beyond web, 63 to 76mm. Edge of extended web, between upper arms, about 101mm; between lateral

arms, about 203^{mm}; entire circumference of web, about 1218^{mm}, but its exact extent cannot be ascertained, because, in our specimen, the web between the ventral arms was badly torn.

The only known example of this remarkable species was taken by Capt. Melvin Gilpatrick and crew, schooner "Polar Wave," in N. lat. 43° 54′; W. long. 58° 44′, on Banquereau, about 30 miles E. of Sable I., N. S., in 250 fathoms. Presented to the U. S. Fish Commission, Sept. 1879 (lot 472).

Notes on the Visceral Anatomy.

The anatomy of this species is very peculiar, but as the original specimen still remains unique, and is not in very good preservation, internally, I do not propose to give more than a few anatomical notes on this occasion. The ventral wall of the mantle cavity is extensively bound down to the visceral mass over a wide central area, by connective and muscular tissue, which does not form a definite septum, found in most other Dibranchiata. This central area underlies, especially, the large nidamental glands and oviduct. Farther back the two sides of the branchial cavity are in communication.

The gills are very peculiar. Each one consists of a short and broad, ovate group or cluster of very much folded or convoluted lamellæ attached directly to the inner surface of the mantle by one edge, and having the free edge much frilled and crisped.

These lamellæ have, however, a somewhat transverse arrangement, and one or two of those nearest the base of the gill, on each side of its median line, are more simple, and are separate from the rest, but those farther out become confluent across the median line, and lose their distinctness. There appears to be about four or five principal lamellæ on each side of the middle line of the gill.

The oviduct is single and nearly median, its orifice being a little to the left of the median line. A large nidamental gland, consisting of a posterior, yellowish portion, and a much larger, round, dark brown, anterior portion, surrounds the oviduct; the portion behind these glands is thin, tubular, and contains large round ova.

The anterior portion, in front of the glands, is large and much thickened, and terminates in a slightly bilabiate orifice, at the base of the siphon. From the portion of the oviduct in front of the large glands I took a large mature egg, covered with a hard, dark reddish brown case. This egg, seen endwise, has a broad elliptical outline, and while the two ends are truncated and smoothish, the sides are ornamented with numerous regular, roughened, elevated ribs. Greatest breadth of the egg, 11^{mm}; lesser breadth, 7^{mm}; length, 6^{mm}. The anal orifice is not raised on a distinct elevation. A small urethral papilla arises in front of the base of each gill.

APPENDIX.

Since the earlier parts of this article were printed, a number of additional specimens of some of the species have been received. Some of these are of importance, as affording additional information in regard to the genera and species, and will, therefore, be mentioned here.

I have also received from Professor J. Steenstrup two recent pamphlets,* relating to the *Ommastrephidæ* and *Teuthida*, printed subsequently to the publication of the pages relating to those families in this article. As these refer directly to the genera and species herein described, they may well be briefly noticed here.

Ommastrephes, Sthenoteuthis, Illex, etc.

Professor Steenstrup, in the first paper referred to, has given a revision of the Ommastrephes-group. He divides the old genus *Ommastrephes* into three genera, viz: I. Illex, which includes *O. illecebrosus*, with *Coindetii*, the closely allied Mediterranean form; II. Todarodes, which includes only the well-known *Ommastrephes todarus* of the Mediterranean, to which he restores the name *sagittatus* Lamarck, which has been otherwise employed by other authors during half a century past; III. Ommatostrephes† (restricted), which corresponds exactly with *Sthenoteuthis*‡ previously established by me. (These Trans., p 222, February, 1880).

* De Ommatostrephagtige Blæksprutter indbyrdes Forhold <Oversight over d. k. D. Vidensk. Selsk. Forhandl., 1880. Presented, April, 1880. [Author's edition received Aug., 1880].

Professor A. E. Verrils [sic] to nye Cephalopodslægter, Sthenoteuthis og Lestoteuthis. Bemærkninger og Berigtigelser, 1 pl. ["avec un résumé en Francais," not received]. From the same, 1881. Advance copy received by me, through the kindness of the author, is dated, in MSS., March 3, 1881.

† I can see no necessity for the proposed reformation of the original spelling of this word by changing it to "*Ommatostrephes*," for usage justifies the elision of a syllable in so long a name. The original spelling has been in good use for over forty years.

‡ Professor Steenstrup also quotes *Cycria* Gray, 1849 (ex Leach MSS.), as a synonym of *Ommastrephes* as restricted, = *Sthenoteuthis*. But in reality it was evidently intended for a group equivalent to *Ommastrephes*, in the extended sense, and as a complete synonym, never in use, it should be dropped. *Hyaloteuthis* Gray, if used at all, should be used in the limited sense, for a minor group, as originally intended.

In another part of this article he refers* to my paper, which had been promptly sent to him, but he makes no reference whatever to the genus *Sthenoteuthis*, nor to the species, *S. megaptera*, which, as a species, had been described by me still earlier (1878) and in far greater detail than most of the other species which he mentions, and which should, under his system of classification, bear the name of *Ommastrephes megaptera*. Nor does he point out any new characters for distinguishing this generic group other than those first given by me, viz: the presence of connective suckers and tubercles on the tentacular arms proximal to the club, and the great development of the membranes on the lateral arms.

Under the ordinary rule of nomenclature, by which the first correct subdivision made in an older genus shall be entitled to priority, while the original name shall be retained for the remaining group, the name *Sthenoteuthis* ought to be maintained for the division first established by me, while *Ommastrephes* (restricted) should be retained for a part or all of the remaining species.† While I very much regret this confusion of names, I perceive no way to remedy it except by the application of the usual rules of priority.

As for the distinction between *Illex* and *Todarodes*, it seems to me very slight and scarcely of generic importance. *Illex* is characterized by having eight rows of small suckers on the distal part of the club, and a smooth siphonal groove. *Todarodes* is characterized by having four rows of distal suckers and some small grooves or furrows at the anterior end of the siphonal groove.

But I have a species (which I refer to *O. Sloanei* Gray), from Tasmania, which agrees with *Illex* in having a smooth siphonal groove, but with *Todarodes* in having only four rows of distal tentacular suckers, and in the sharp denticulation of its large suckers. According to Steenstrup's system this would have to be made still another genus, or else his generic characters would have to be greatly

* In discussing (p. 233, foot note) my statements in respect to the sexual differences in proportions. It is to be hoped that Prof. Steenstrup will find in the tables of measurements given in the preceding pages all the data needed to settle this matter more satisfactorily.

† Professor Steenstrup considers *O. Bartramii* as the "typical" species of *Ommastrephes*. But in fact D'Orbigny did not give any particular species as the *type* of his genus. His description applies better to such forms as *O. todarus* and *O. illecebrosus*, for he does not mention the connective tubercles and suckers of the tentacular arms. Nor is it certain that *O. gigas*, one of the earliest species referred to this genus, has such structures. The species thus named, even by Professor Steenstrup, is so called only with a mark of doubt.

changed in order to admit it into either of his groups. The existence of eight rows of suckers in '*Illex*' seems to be due merely to the crowding together of the ordinary four rows; nor can we attach much importance to the superficial furrows in the siphon-groove. Therefore, my own opinion still is that *Illex* and *Todarodes* should be reunited, and should retain the name *Ommastrephes*, in a restricted sense. The absence of connective suckers and tubercles on the tentacular arms will be the most important diagnostic character to distinguish it from *Sthenoteuthis* and *Architeuthis*.

In this paper, Professor Steenstrup gives figures (cuts) which, with the descriptive remarks, will, at last, enable others to identify his *S. pteropus* with more certainty. He has given diagramatic cuts of the base of the tentacular clubs, showing the arrangement of the connective suckers and tubercles of *S. pteropus*, *S. Bartramii*, *S. gigas*, *S. pelagicus*, *S. oualaniensis*, and *Dosidicus Eschrichtii* [p. 11], and cuts [p. 9], showing the siphonal grooves of *Sthenoteuthis pteropus*, *S. Bartramii*, *S. pacificus*, *Ommastrephes sagittatus* (="*O. todarus*"), and *O. Coindetii* (="*O. sagittatus*," auth.). On pp. 19 and 20 he has given a synoptical table of the several genera that he recognizes in this group, which he names, *Ommatostephini* (= *Ommastrephida* Gill, Tryon, Verrill). On plate 3, he figures "*Illex Coindetii*," female, with the gill-cavity opened, showing a large cluster of spermatophores attached to the inner surface of the mantle, behind the base of the gill, and a smaller one, in front of the gill.

In the second article referred to, Professor Steenstrup discusses the genus *Sthenoteuthis* versus "*Ommatostrephes*." He recognizes the identity of *Sthenoteuthis* and his restricted genus *Ommatostrephes*, as well as the priority of date of the former. He also refers to *S. megaptera*, as "*Ommatostrephes megaptera*."

Lestoteuthis= *Cheloteuthis*= *Gonatus* Steenst. (non Gray).

The second of Professor Steenstrup's papers contains a detailed discussion of *Gonatus Fabricii* Steenst., with which he also unites *Onychoteuthis Kamtschatica* Midd., the type-species of my genus *Lestoteuthis* (see p. 250). He may be correct in uniting these forms, for he states that he has received specimens that agree with *Gonatus Fabricii*, from the North Pacific.* Moreover, taking the characters of the genus *Gonatus*, as *now understood*, by Professor

* The figures, however, show differences in the form of the pen and caudal fin, which, if correct, may still indicate specific differences.

Steenstrup, the description and figures of Middendorff's species apply well to that genus, and my description of *Lestoteuthis* well defines *Gonatus* Steenst., except for the mistake in regard to the tip of the pen. But when I proposed the genus *Lestoteuthis*, no writer had ever so described *Gonatus*, and the data necessary for the correlation of the two species *did not exist* in the literature of the subject. I have already alluded (pp. 290–292 and elsewhere), to some of the very serious errors of Gray, H. & A. Adams, and others, as to the *generic* and even *family* characters of *Gonatus*.* Professor Steenstrup, in his last paper, has exposed a greater number of errors, some of which are questionable. He has, however, been fortunate in securing specimens of larger size and in better condition than those examined by other writers, and has given good figures and a very full exposition of the characters of this very interesting species. Two excellent specimens were taken by our party, this season, on the "Fish Hawk." One of these is an adult male; the other is young, with the mantle 30^{mm} long. The latter agrees well in size and form with the specimen described and figured by G. O. Sars, as *Gonatus amœnus*, while the former† agrees with Steenstrup's figure of the adult *G. Fabricii*. But both differ decidedly from a Cumberland Gulf specimen, which is doubtless the *real Gonatus amœnus* Gray, and has four rows of true suckers on all the arms, and no hooks. It does not appear that Steenstrup has seen this form.

The fortunate acquisition of these specimens has enabled me to ascertain, for myself, not only that Professor Steenstrup is correct in considering two forms that have been described from the North

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*The genus *Gonatus*, as established by J. E. Gray, if we judge by his description, was a very different group from what Steenstrup understands by it. Among the false characters given by him are the following: 1, It was said to have no eyelids; 2, to have no valve in the siphon; 3, to have no siphonal dorsal band. But he also says that it has nearly equal and similar suckers in four series, on all the arms, "all with small circular rings"; and the club was said to have "ranges of small, nearly sessile, equal-sized cups," with one "large sessile cup, armed with a hook in the middle of the lower part." From the fact that he received his specimens from Greenland (coll. Möller), we must believe that he actually had before him the real *G. amœnus!* My specimen from Cumberland Gulf has true suckers, as described by Gray, *on all the arms*.

Most of Gray's errors have been copied and adopted by Woodward, H. & A. Adams, Tryon, and many other writers.

†I have had figures of the larger specimen made by Mr. Emerton, for my Report on the Cephalopods, now printing in the Report of the U. S. Fish Commission, for 1879. Some of these are also reproduced on Plate LV, figs. 1–1*d*.

Atlantic, as simply the young and adult of the same species, but also that all the essential and peculiar features of the armature, both of the sessile and of the tentacular arms, including the special, lateral connective suckers and tubercles of the club, are present, though minute, even in the very young individuals, such as described by G. O. Sars. The fact that these characters have been overlooked is undoubtedly due, in many cases, to the imperfectly preserved specimens that have been examined. This was, at least, the case with the only American specimens seen by me until this year. They had all been taken from fish stomachs, and had lost more or less of their suckers and hooks.

A careful direct comparison of the adult *G. Fabricii*, with the mutilated specimen which was last year described by me as *Cheloteuthis rapax*, has convinced me that they are identical, and, therefore, *Cheloteuthis* becomes a synonym of *Lestoteuthis*. Two of the characters, viz: the supposed presence of two central *rows of hooks* on the ventral, as well as on the lateral arms, and the supposed *absence* of the small marginal suckers on the lateral arms, relied upon for characterizing *Cheloteuthis*, were doubtless due to post-mortem changes. The ventral arms had lost the horny rings of the suckers, and the soft parts had taken a form exceedingly like that of the sheaths of the hooks of the lateral arms. But by the careful use of reagents I have been able to restore the original form of some of the distal ones sufficiently to show that they actually were sucker-sheaths. The third character, originally considered by me as more reliable and important, was the existence of the peculiar, lateral connective suckers and alternating tubercles on the tentacular club. This is *now* shown by Professor Steenstrup to be a character of his *Gonatus*. But no one had previously described such a structure in connection with that genus. Even in the recent and excellent work of G. O. Sars, in which "*G. amœnus*" is described in some detail, and freely illustrated, there is no indication of any such structure, although the armature of the club is figured (see my Pl. 45, fig. 1*b*), nor is the difference between the armature of the ventral and lateral arms indicated.*

I add a new description of the genus *Lestoteuthis*, and also of my largest example of *L. Fabricii*.

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*According to Gray, in *Gonatus* all the sessile arms bear four rows of similar and nearly equal suckers; according to G. O. Sars they all have two central rows of sucker-hooks. My description (p. 290) was based mainly on the figures and description of G. O. Sars, my only specimen, at that time, being an imperfect young one.

Lestoteuthis Verrill, (revised).

Gonatus Steenstrup, op. cit., pp. 9–26, (non Gray).
Gonatus Verrill, this volume, pp. 250, 290, 1880, (non Gray).
Lestoteuthis Verrill, this volume, p. 250, Feb., 1880.
Cheloteuthis (*Chiloteuthis* by typ. error) Verrill, this volume, p. 292, Jan., 1881.
Cheloteuthis Verrill, Bulletin Mus. Comp. Zool., viii, p. 109, March, 1881.

Odontophore with only five rows of teeth.* Mandibles very acute, strongly compressed. Lateral connective cartilages of the mantle are simple ridges; those of the siphon ovate. Nuchal olfactory crests one or more on each side, longitudinal. Caudal fin, of adult, large, spear-shaped. Ventral arms with four rows of denticulated suckers. No trace of hectocotylization detected.† Lateral and dorsal arms with two marginal rows of small suckers and two median rows of large hooks. Tentacular arms with a central row of hooks, the two distal ones largest; with a large distal and two lateral groups of small suckers, in numerous rows; and with a lateral group of peculiar connective suckers, alternating with tubercles, near the lower margin, and a row of smaller ones extending for a long distance down the margin of the arm; upper margin of the arm with a band of small, pediceled suckers along about half its length. Pen narrow, with a short, hollow, posterior cone.

Gonatus Gray, typical, (non Sars, Steenst.) differs in having four rows of true suckers, similar on all the arms. This may be a sexual character, but the two forms should be kept separate, awaiting farther evidence. Steenstrup does not give the sex of his specimens.

Lestoteuthis Fabricii (Licht.) Verrill. (See pp. 291–294.)

?Onychoteuthis Kamtschatica Middendorff, 1849.
Gonatus Fabricii Steenstrup (*pars*), in Mörch, Faunula Molluscorum Ins. Færöerne, Vid. Meddel. nat. For., 1867, p. 102; Faunula Molluse. Islandiæ, Vid. Meddel. nat. For. Kjöbenhavn. 1868, p. 227.
Gonatus Fabricii Mörch (*pars*), in T. R. Jones, Arctic Manual, p. 130, 1875.
Steenstrup, Oversigt over d. Kongl. D. Vidensk. Selsk. Forh., 1881. [Sep. copy, p. 26,] pl. 1, figs. 1–7.
Verrill, (*pars*) this volume, p. 291.
Cheloteuthis rapax Verrill, this volume, p. 293, pl. 49, figs. 1–1^{f}; Bulletin Mus. Comp. Zool., viii, p. 110, pl. 2, figs. 1–1^{f}, 1881; Report U. S. Fish Com. for 1879, p. [76], pl. 15, figs. 3–3^{f}, 4, dentition, 1881.
Lestoteuthis Fabricii Verrill, Report of U. S. Fish Com. for 1879, p. [79], pl. 15, figs. 1–1^{c}, 2–2^{d}, pl. 45, figs. 1–1^{d}, 1881.

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* The dentition of the type-specimen of *Cheloteuthis rapax* was figured and described by me, several months ago, in the report of the U. S. Fish Com., for 1879.

† My largest specimen, although apparently adult, is not sexually mature. An older specimen might be hectocotylized.

PLATE XLV, FIG. 1–2*d*. PLATE XLIX, FIG. 1–1*f*. PLATE LV, FIG. 1–1*d*.

Body elongated, tapering to an acute posterior end; anterior edge of mantle nearly even dorsally, with a slight median emargination; lateral angles well-marked, in line with the internal connective cartilage, which forms a long, simple, longitudinal ridge. Caudal fin broad spear-shaped, broadest in advance of the middle; the lateral angles are well rounded; the tip is very acute; the anterior lobes are broadly rounded, projecting forward beyond the insertion. Head large, short and broad; eyes large, occupying most of the sides of the head; eye-lids well developed, thickened, with a narrow, oblique sinus. Siphon large, in a deep groove, with two stout, dorsal bridles; lateral connective cartilages large, long-ovate, posterior end broadest. One olfactory crest on each side, behind the eye, in the form of a low, longitudinal membrane; slight indications of another, lower down; a small, fleshy, flattened, projecting papilla near the auditory opening. The outer buccal membrane has seven distinct angles. Arms rather long and strong; trapezoidal in section. The dorsal arms are considerably shorter than the others; order of length is 1, 2, 4, 3; the 3d is but little longer than the second pair; ventral arms decidedly more slender than the others.

Ventral arms with four rows of denticulated suckers, those of the two inner rows larger; lateral and dorsal arms with two marginal rows of small suckers and two inner rows of larger incurved hooks, enclosed, except at the sharp tips, in muscular sheaths, which have lateral basal expansions and short pedicels (Pl. LV, fig. 1*b*). Tentacular arms* long and strong, quadrangular; in my specimen they reach back beyond the base of the fin; the club is large and broad, with a long, narrow distal portion, having a strong dorsal keel; in the middle are two very large, curved hooks (fig. 1, 1*a*), the distal one smaller; proximal to these there is a row of five smaller hooks, decreasing proximally, and between these and the large hooks there is, on one arm, a single small sucker; on the other arm a single sucker takes the place of the proximal hook, while an odd, small sucker stands to one side of the row; along the upper margin of the club there is a broad band of small, denticulated suckers, on long pedicels, arranged in oblique, transverse rows of five or six; this band of suckers is interrupted opposite the large hooks; beyond the hooks

* The figure given (pl. XLIX, fig. 1,) of the somewhat injured tentacular club of the type of *Cheloteuthis rapax*, represents the structure nearly correctly, but many of the small suckers and tubercles on the arm, below the club, had been destroyed, the edge above *e'* is injured, and of the large hooks (*a*, *a'*) only the sheaths remain.

a large group of similar small suckers covers nearly the whole distal portion of the club (Pl. LV, fig. 1); at the tip of the club there is a circle of small smooth suckers; along the lower margin of the middle portion of the club there is a band of small suckers, like those on the other margin; along the basal third of the margin and supported on a thickened marginal expansion of the club, there is a row of six special, smooth, connective suckers, at the inner ends of transverse, muscular ridges (fig. 1, *e*); between and alternating with these suckers, there are deep pits and as many small, round tubercles, destined to fit the suckers and ridges of the other club; continuous with these a row of similar, but smaller, sessile, connective suckers and tubercles extends down along the margin of the inner face of the arm, for about half its length, becoming smaller and more simple proximally; an irregular band, formed of two or three rows of small, pediceled and denticulated suckers, extends down the other margin of the arm, with some scattered ones along the middle.

The pen (Pl. LV, fig. 1*d*) is thin, long and narrow; anterior part about half as wide as the middle portion, slender, concave, with thickened margins; the anterior end is very thin, acute; the two marginal ribs converge gradually, as they run backward, and unite near the posterior end; the widest part of the pen is a little behind the middle; the thin margins begin at about the anterior third, gradually increasing in width to the widest part, when they still more gradually decrease posteriorly; but toward the end they expand into the obliquely hooded portion, or terminal hollow cone; this portion is strengthened by a dorsal mid-rib, and by numerous small ribs which radiate forward from the tip, one on each side being stronger than the rest. In life, the cone contained part of the testicle, and at the tip a cartilaginous core. Length of pen, in alcohol, 133^{mm}; greatest breadth, 7^{mm}; of shaft, 2·5^{mm}; length of cone, on shortest side, 7^{mm}.

General color of body, fins, head and arms, deep reddish brown, tinged with purple; back darkest; the color is due to large chromatophores rather uniformly and closely scattered over the whole surface; on the arms and siphon they are smaller, but they cover all the surfaces of the arms, except the lower side of the tentacular arms and the face of the club. Total length, 263^{mm} (10·25 inches); length of mantle, 153^{mm} (6 inches); length of dorsal arms, 57^{mm}; of 2d pair, 71^{mm}; of 3d pair, 77^{mm}; of 4th pair, 70^{mm}; of tentacular arms, 100^{mm}; length of tail, from insertion, 63^{mm}; from anterior lobe, 70^{mm}; greatest breadth, 68^{mm}; breadth of head, 29^{mm}.

Notes on the visceral anatomy of the male.

In its anatomy this species resembles *Ommastrephes*. The branchial cavity is very large, extending back nearly to the base of the fin; the median longitudinal septum is far back, gills very long, but not reaching the margin of the mantle, attached nearly to the tip; its structure is like that of *Ommastrephes*. Liver orange-brown, very large, massive, nearly as in *Ommastrephes*, but larger, extending back farther than the base of the fin. The circulatory and renal systems are similar to those of *Ommastrephes*, in most respects. The posterior aorta goes back some distance before it divides, about opposite the base of the fin, into the medio-ventral artery of the mantle, and a caudal artery. Two large ventral renal organs lie below and to each side of the heart, and blend together, in front of it, into a large mass, which has a pointed lobe extending forward; posteriorly two lobes extend back, as usual, along the posterior venæ-cavæ. The first stomach is rounded and the second stomach is a large, long-pyriform sac; the intestine is long, the ink-sac is long-pyriform. The reproductive organs are small, indicating that the specimen is still immature, and probably only one year old. The spermary or "testicle" is small (length 18^{mm}, diameters 2^{mm} and 4^{mm}), flattened, tapering backward, partly enclosed by the hooded portion of the pen, and with the anterior end attached laterally to the posterior end of the cæcal lobe of the stomach. The prostate gland, vesiculæ-seminales and spermatophore-sac are small; the efferent duct is long and slender, extending forward over and beyond the base of the left gill.

Moroteuthis, gen. nov.

Type, *Onychoteuthis* (or *Lestoteuthis?*) *robusta*, this vol., pp. 246–250.

Moroteuthis robusta Verrill, Report of the U. S. Fish Commission for 1879, pp. [65–71], pls. 13 and 14, 1881.

After referring the type of *Lestoteuthis* to *Gonatus* (not of Gray), Professor Steenstrup admits that the gigantic species, *L. robusta* V., is the representative of a distinct genus, to which he would restrict the name *Lestoteuthis*.

But *L. Kamtschatica* was specially given by me as *the type of Lestoteuthis*, and the characters of the genus were derived entirely from that species, while *L. robusta* was referred to it only with great doubt, owing to the fact that its armature is almost unknown. Therefore, if *Lestoteuthis* hereafter becomes a complete synonym, it should be dropped, when it cannot be kept for its special type-species. For the gigantic species I have proposed (Am. Jour. Sci., xxii, p. 298, Oct., 1881,) a new genus, *Moroteuthis*.

This genus will have, as known characters: A long, narrow, thin pen, terminating posteriorly in a conical, hollow, many-ribbed, oblique cone, which is inserted into the oblique, anterior end of a long, round, tapering, acute, *solid*, cartilaginous terminal cone, composed of concentric layers, and corresponding to the solid cone of *Belemnites* in position and relation to the true pen; elliptical connective cartilages on the base of the siphon; nuchal, longitudinal crests, three, much as in *Ommastrephes;* eye-lids with a distinct sinus; caudal fin large, broad, spear-shaped, ventral arms with smooth-rimmed suckers at the base. The rest of the armature is unknown.

Moroteuthis robusta is the only known species.

Architeuthis Harting, 1861. (See pp. 197, 238, 239.)

Architeuthus Steenstrup, Förhandl. Skand. Naturf., 1856, vii, p. 182, 1857 (no description).

The characters of this genus, as given on p. 197, must be modified, so far as the *pen* is concerned, in accordance with the description given below.

Professor Steenstrup, in the second of the papers above cited (see p. 385) criticises me (and others) for writing Architeuth*is* instead of Architeuth*us*, as he originally spelled the word. So far as I am personally concerned, I am free to confess that I had always supposed that his original spelling was a typographical error, and as the genus at that time was merely *named*, but in no sense *established* nor *defined*, as a matter of necessity I adopted the name as spelled in the earliest published work (that of Harting), in which the characters of the genus were so far indicated as to make it possible to recognize it. Harting states that he was in correspondence with Professor Steenstrup, in regard to this genus, and that he had received from him drawings and proofs of unpublished plates of *Architeuthis*. Therefore, the blame, if any, for the change in spelling, must rest mainly with Harting. Moreover, Gervais, who had seen and briefly described Professor Steenstrup's specimens, also wrote *Architeuthis*, and that has been the general practice with nearly all European writers, for twenty years. Therefore, I do not see the propriety of specially criticising Mr. Tryon and myself for using this spelling, which has been so extensively adopted in Europe.

That the original form of the word would have been preferable, I do not deny. But that there is any special impropriety in the termination *teuthis*, even for a *large* cephalopod, it is useless to insist upon, for that termination has been generally adopted by many writers, and during many years, for several genera, living and fossil,

of both large and small cephalopods. Thus Professor Steenstrup, himself, notwithstanding his demonstration of the etymological absurdity of the names, uses "*Enoploteuthis*," "*Lestoteuthis*" for genera that include species about as *large* and *powerful* as *Architeuthus*. Although *teuthis*, in classical Greek, may signify a *small* and *weak* cephalopod, as a zoological term it no longer has that meaning. But if the change had not been made by others, apparently with good reasons, I should certainly not have adopted it, for it is not in accordance with my practice to change or "reform" the original spelling of generic or specific names, unless for very urgent and obvious reasons.

On the tentacular club of this and numerous other related genera, there is a peculiarity that I have not seen definitely described. Between the rows of large suckers there is, as described already, a central zigzag ridge, which sends off transverse ridges between the suckers, defining shallow pits around each sucker-pedicel. These pits are lined, however, with a thin, partially free membrane, which surrounds the base of the pedicel, like a collar, leaving an open space on all sides, except the inner, where it is attached to the pedicel. The space beneath this membrane freely communicates with the spaces beneath the other sucker-pits, by means of open spaces beneath the zigzag central and transverse ridges.

A similar structure, but less developed, exists in *Ommastrephes*, *Histioteuthis*, *Loligo* and other genera. These collar-like membranes are probably able to embrace and support the pedicels, when the suckers are in action.

Architeuthis Harveyi Verrill. (See pp. 197, 259.)

Since the publication of the descriptions of this species I have made a more thorough examination of the various mutilated fragments of the pen, and have compared them more fully with the corresponding parts of the pen, in other genera. From these studies I became convinced that the portions of the pen formerly supposed by me to belong to the anterior, really belong to the posterior end.* Consequently the description on pages 206–208, should be corrected by substituting posterior for anterior, throughout, with other concordant changes. The explanation of the figure (Pl. XV, fig. 3) should also be corrected, in the same way. To correct this mistake

* The description of the pen was corrected in my Report on Cephalopods (pp. 31–33] in the Report of the U. S. Fish Commissioner, put in type last year.

more effectually, I here give a new description of the pen, based on these fragments, arranged as I now understand the form and structure.

New description of the pen of Architeuthis Harveyi V.

The parts preserved all belong to the posterior blade, which is now flattened and much mutilated, but it was very thin and broad, running out to attenuated borders; and it apparently had a small, acute, hooded terminal portion, or thin hollow cone, perhaps only two or three inches long, while the broad blade itself must have been more than two feet long and upward of a foot wide, when flattened out. No part of the narrow anterior shaft, which probably existed, is preserved.

The extreme posterior end is gone, but the convergent ribs indicate that it tapered to a point; each edge of the present end, for rather more than an inch, is thickened by a more divergent marginal rib, running into the edge and disappearing, while the edges here appear to have been torn apart, and this portion appears to have constituted the hooded portion; beyond this the margins run out to a very thin and ill-defined edge. The midrib, or dorsal keel, is at first sharply angular with a triangular section, and the slender lateral costæ are completely confluent with it, but a little farther forward these begin to become distinct and slightly divergent, till at about ten inches from the end they are about an inch from the midrib; except close to the posterior end, the midrib is regularly rounded, or nearly semi-cylindrical. Near the posterior end there are three or four other slightly thickened, divergent ribs, on each side, between the midrib and the margin, but all these, except the inner ones, soon run obliquely to the margins and disappear; probably these mark the portion that was incurved or partially hooded. The surface is marked by fine striæ between and parallel to the ribs, but the oblique, divergent striæ, so conspicuous in *Sthenoteuthis*, are scarcely apparent. The midrib has nothing of the double or grooved character seen in that of *Sthenoteuthis* and *Ommastrephes*, the divergent ribs are much less numerous, and the whole structure is much more thin and flexible and the marginal portions much more ill-defined and membranous.

Architeuthis abundant in 1875 *at the Grand Banks.*

From Capt. J. W. Collins, now of the United States Fish Commission, I learn that in October, 1875, an unusual number of giant-squids were found floating at the surface on the Grand Banks, but

mostly entirely dead, and more or less mutilated by birds and fishes. In very few cases they were not quite dead, but entirely disabled. These were seen chiefly between north latitude 44° and 44° 30′, and between west longitude 49° 30′ and 49° 50′. He believes that between 25 and 30 specimens were secured by the fleet from Gloucester, Mass., and that as many more were probably obtained by the vessels from other places. They were cut up and used as bait for codfish. For this use they are of considerable value to the fishermen. Captain Collins was at that time in command of the schooner "Howard," which secured five of these giant-squids. These were mostly from 10 to 15 feet long, not including the arms, and averaged about 18 inches in diameter. The arms were almost always mutilated. The portion that was left was usually 3 to 4 feet long, and at the base, about as large as a man's thigh.

One specimen (No. 25), when cut up, was packed into a large hogshead-tub having a capacity of about 75 gallons, which it filled. This tub was known to hold 700 pounds of codfish. The gravity of the *Architeuthis* is probably about the same as that of the fish. This would indicate more nearly the actual weight of one of these creatures than any of the mere estimates that have been made, which are usually much too great. Allowing for the parts of the arms that had been destroyed, this specimen would probably have weighed nearly 1,000 pounds.

Among the numerous other vessels that were fortunate in securing this kind of bait, Captain Collins mentions the following:

The schooner "Sarah P. Ayer," Captain Oakley, took one or two.

The "E. R. Nickerson," Captain McDonald, secured one that had its arms, and was not entirely dead, so that it was harpooned. Its tentacular arms were 36 feet long (No. 26).

The schooner "Tragabigzanda," Captain Mallory, secured three in one afternoon. These were 8 to 12 feet long, not including the arms.

These statements are confirmed by other fishermen, some of whom state that the "big squids" were also common during the same season at the "Flemish Cap," a bank situated some distance northeast from the Grand Banks.

The cause of so great a mortality among these great Cephalopods can only be conjectured. It may have been due to some disease epidemic among them, or to an unusual prevalence of deadly parasites or other enemies. It is worth while, however, to recall the fact that these were observed at about the same time, in autumn, when most of the specimens have been found cast ashore at New-

foundland in different years. This time may, perhaps, be just subsequent to their season for reproduction, when they would be so much weakened as to be more easily overpowered by parasites, disease, or other unfavorable conditions.

I have heard of no authentic instances* of the occurrence of specimens of this species since the finding of the small specimen (No. 24), in April, 1880. [See p. 259.]

Large Species from New Zealand.

Architeuthis Mouchezi ? (See p. 243.)

Mr. T. W. Kirk, in the Transactions of the Wellington Philosophical Society, for October, 1879, p. 310, has published accounts of the occurrence of five specimens of "giant cuttle-fish" on the coast of New Zealand:

No. 1. The first of these was cast ashore at Waimarama, east coast, in September, 1870. Of this the beak was preserved and sent to Mr. Kirk by Mr. Meinertzhagen, whose account of the occurrence, with a rather crude description and some measurements made by an eye-witness, Mr. Kirk has printed. He gives no description of the beak, unfortunately. The dimensions given are as follows: Length from tip of tail to root of arms, 10 feet 5 inches; circumference, 6 feet; length of arms, 5 feet 6 inches. "The beast had eight tentacles, as thick as a man's leg at the root; horrid suckers on the inside of them, from the size of an ounce bullet to that of a pea at the tip; two horrid goggle eyes; and a powerful beak between the roots of the arms. His head appeared to slip in and out of a sheath. Altogether he was a most repulsive looking brute."

It is probable that this specimen had lost its two tentacular arms before death, and that it was actually of the same species as the other specimens recorded by Mr. Kirk. Mr. Kirk, however, seems to think that the above description refers to an Octopod.

No. 2. "The beak of number 2 was deposited in the Colonial Museum by Mr. A. Hamilton. The animal was captured at Cape Campbell by Mr. C. H. Robson, a member of this society, who very kindly furnished me with the following information. Writing on the 19th of June, 1879, he says:

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* A purely fictitious and sensational account of an imaginary capture of an *Architeuthis* has been published in Lippincott's Magazine, for Aug., 1881, p. 124, by Mr. Charles F. Holder.

"'In reply to yours of the 12th about the cuttle-fish, I may state that while stationed at Cape Campbell I found several specimens of large size, all, however, more or less mutilated, except one, the beak of which I gave to Mr. Hamilton. It was alive and quite perfect, the body being 7 feet long, eight sessile arms 8 feet long, and two tentacular arms 12 feet long. I am, however, only writing from memory. Mr. Hamilton has the exact measurements, and I remember distinctly that the total length was close on 20 feet.'

"I am sorry to say that Mr. Hamilton has mislaid the notes and measurements, but those given above cannot be far out."

No. 3. The third specimen was examined and measured by Mr. Kirk, personally, where it lay on the beach. He made a drawing of it, which has not yet been published, to my knowledge. It was found on the beach at Lyall Bay, May 23, 1879, by three boys. Mr. Kirk states that it had been somewhat mutilated by the natives before he saw it, and the pen or bone had been cut across; but he preserved all the pieces of the pen, the beak, tongue, and some of the suckers. Most of the suckers had been torn off.

"The length of body from tip of tail to anterior margin of the mantle was 9 feet 2 inches, and 7 feet 3 inches in circumference; the head from anterior margin of mantle to roots of arms, 1 foot 11 inches; making the total length of the body 11 feet 1 inch. The head measured 4 feet in circumference. The sessile arms measured 4 feet 3 inches in length, and 11 inches in circumference. Each of these arms bore thirty-six suckers, arranged in two equal rows (as shown by the scars), and measuring from $\frac{13}{16}$ to $\frac{1}{4}$ of an inch in diameter. Every sucker was strengthened by a bony ring armed with from forty to sixty sharp incurved teeth. The tentacular arms had been torn off at the length of 6 feet 2 inches, which was probably less than half their original length."

"The fins were posterior, and were mere lateral expansions of the mantle. They did not extend over the back, as in the case with *Onychoteuthis*, &c. Each measured 24 inches in length and 13 inches in width.

"The cuttle-bone, when first extracted, measured 6 feet 3 inches in length and 11 inches in width, but has since shrunk considerably. It was broadly lanceolate, with a hollow conical apex $1\frac{1}{2}$ inches deep."

No. 4. "Another specimen, measuring 8 feet in length, was lately caught by a fishing party near the Boulder Bank, at Nelson, concerning which I have only seen a newspaper cutting, and have not been able to obtain particulars."

No. 5. "A fifth was found by Mr. Moore, near Flat Point, east coast. A description was sent to Mr. Beetham, M. H. R., who, I believe, intends communicating it to this society."

From the above descriptions, alone, it is not possible to decide with certainty whether these specimens belong to the *Architeuthis*-group, or whether they are more nearly allied to the *Onychoteuthis*-group, like *Moroteuthis*, for the armature of the tentacular arms is not known. The broad-lanceolate form of the pen, with a small conical hood at the end, would seem to indicate affinities with *Architeuthis*, and the presence of true suckers, on the sessile arms, and small size of the fins, are favorable for that view. Altogether, the descriptions indicate that this New Zealand species is related to, and perhaps identical with, the one discovered at the Island of St. Paul, and first named by M. Vélain *Architeuthis Mouchezi*. It is to be hoped that Mr. Kirk will soon give detailed descriptions and figures of the portions in his possession.

Plectoteuthis grandis Owen = Architeuthis grandis.

Plectoteuthis grandis Owen, Descriptions of some new and rare Cephalopoda, Part II.<Trans. Zool. Soc. London, xi, part 5, p. 156, pl. 34, 35, June, 1881.

Professor Owen, in the paper quoted, has given a somewhat detailed description, with figures, of the large cephalopod arm, long preserved in the British Museum, and which had previously been pretty fully described by Mr. Saville Kent, in 1874, whose description has already been quoted by me (see pp. 241, 242). Professor Owen, like Mr. Kent, fails to state to which pair of arms the specimen belongs. This is a very important omission, for in *Architeuthis*, as in many other genera, the arms belonging to different pairs differ in form and structure. The describers of this arm would doubtless have been able to ascertain to which pair it belonged by a direct comparison with the arms of *Ommastrephes*, or any other related form.

For this arm, Professor Owen endeavors to establish a new genus and species (*Plectoteuthis grandis*). The genus is based mainly on the fact that there is a marginal crest along each outer angle, and a narrow protective membrane along each side of the sucker-bearing face. These peculiarities are precisely those seen in the *ventral arms* of *Architeuthis*, and have already been described by me in former articles, and in this report (see pp. 214, 261, 262), both as found in *A. Harveyi* and *A. princeps*. Similar membranes or crests are found

on the *dorsal* arms of *Sthenoteuthis pteropus* (see Pl. XXXVI, fig. 7, *a*) and other related species.

The suckers on the arm, as described and figured by Professor Owen, are like those of *Architeuthis*. Therefore, there is no ground whatever for referring this arm *to any other genus*, and *Plectoteuthis* must, therefore, become a synonym of *Architeuthis*.

Whether the arm in question belongs to a species distinct from those already named, I am unable to say. There is, apparently, nothing to base *specific* characters upon except the form of the suckers and of their horny rings. But the description of the horny rings is not sufficiently precise, nor the figures sufficiently detailed, to afford such characters. If the arm is one of the ventral pair, as seems probable, the suckers as figured by Professor Owen, and especially as more fully described by Mr. Kent, agree very closely, but not perfectly, with those of either of the Newfoundland specimens, for in the latter the suckers of the ventral arms are strongly toothed externally, but are either entire, or in some cases, only slightly denticulated on the inner side. But they also agree well with those of the *Architeuthis Hartingii*, as figured by Harting. Those of the original *A. dux* Steenst., have neither been described nor figured. In Owen's figures the large suckers are represented as denticulated pretty evenly all around the edge. As this arm cannot, at present, be referred with certainty to any of the named species, it may be best to record it as *Architeuthis grandis*, until better known.

In the same article Professor Owen has given a good figure (pl. 33, fig. 2) of the tentacular arm of the Newfoundland specimen (my No. 2) copied from the same photograph described by me (see pp. 182, 208, 209). To this he applies, doubtless by mistake, the name, *Architeuthis princeps*,* without giving any reason for not adopting my conclusion that it belongs to *A. Harveyi*. But he does not, in any way, refer to the latter species, although he mentions the specimen (my No. 5), or rather the photograph of the specimen, on which that species was based. He apparently (on page 162) supposes that both photographs and all of Mr. Harvey's measurements refer to the same

* By a singular mistake, Professor Owen, on page 163, states that this species was named *A. princeps* by Dr. Packard, in February, 1873. But according to his own statement, on page 161, the specimen was not actually obtained till December, 1873, *at least nine months after* Dr. Packard's article was printed. In truth, the name *princeps* was first given by me in 1875, to designate a pair of large jaws, as explained on page 210. Neither this nor any other name appears on the cited page of Dr. Packard's article, though he elsewhere referred these jaws doubtfully to *A. monachus*.

specimen, which is by no means the case, as had been sufficiently explained by me in several former papers.*

The brief account given by Professor Owen of the large Cephalopods described by others, includes none additional to those noticed by me in this report. On the other hand, he omits those described by Harting; those described by Mr. Kirk, from New Zealand; those from Alaska; and several others.

Sthenoteuthis Verrill (see pp. 222, 286.)

Xiphoteuthis (sub-genus) Owen, op. cit. p. 104. pl. 28, figs. 1, 2, June, 1881 (*non* Huxley).

In the paper referred to above,† Professor Owen has described a cephalopod, without locality, under the name of *Ommastrephes ensifer*, for which he proposes the sub-generic name *Xiphoteuthis*. His species is a typical example of my genus *Sthenoteuthis* (1880) and appears to be identical, in every respect, with *S. pteropus* (see p. 228, Pl. XXXVI, figs. 5–9, and Pl. LIV, figs. 2, 2*a*), as described by me. But Professor Owen fails to mention one of the most characteristic features of this group of squids, viz: the connective tubercles and smooth suckers on the proximal part of the tentacular club, nor is his figure sufficiently detailed to indicate this character, nor even the actual arrangement and structure of the other suckers of the club. The high median crest and broad marginal web of the third pair of

* It seems incredible that Professor Owen could have made these mistakes had he examined either of my former papers in which these specimens have been described in detail, not only from the photographs, but from the preserved specimens. He does, however, refer to Part I, of this article, published in 1880. But as he states (p. 162) that in it "a brief notice is given of Mr. Harvey's squid" it is fair to suppose that the reference is taken at second-hand, for it is not to be supposed that he would have considered my description, covering over 20 pages, and accompanied by nine plates, as a "*brief notice.*" None of my earlier papers are referred to, nor does he mention the large species, *Moroteuthis robusta*, in his account of the large Cephalopods hitherto described.

† Among other species figured and described in this paper, there is a handsome species from the China Sea, described as *Loligopsis ocellata*, sp. nov. (pp. 139–140, pl. 26, figs. 3–8, pl. 27, figs. 1, 2).

This is evidently not a true *Loligopsis* and belongs, in all probability, to my genus *Calliteuthis*. It agrees very closely, even to the coloration, and the form of the fins and pen, with my *C. reversa*, but differs in having serrate suckers. This species should, therefore, be called *Calliteuthis ocellata*. It is much larger than my specimen, but like the latter, had lost the tentacular arms. The genus probably belongs to the Chiroteuthidæ.

arms are well shown, but these are about equally broad in *S. pteropus* and *S. megaptera*, and are also present in all the related species of this group.

Owen's specimen had a total length of 3 feet; length of body, 15 inches; of head to base of dorsal arms, 3·7; of third pair of arms, 12; of tentacular arms, 21; breadth of caudal fin, 12·6; length of their attached bases, 6·6; breadth of body, 5; length of 1st, 2d, 3d, 4th pairs of arms, 8·9, 11, 12, and 9·6 inches, respectively. The specimen is a female. It agrees very closely in size with the Bermuda specimen described by me, and its proportions do not differ more than is usual with alcoholic specimens of any species, preserved under different circumstances, and in alcohol of different strength. The original specimen of *S. megaptera* is considerably larger.

Ommastrephes illecebrosus V. (See p. 268.)

This species was taken in many localities, this year, by the U. S. Fish Commission, in deep water, off Martha's Vineyard. Most of the living specimens were young, but large ones were often taken from the stomachs of bottom-dwelling fishes, in the same region, showing conclusively that it regularly inhabits those depths.

Additional Specimens examined.

Station.	Locality.	Fath.	Date.	Rec'd from	Specimens. No.	Sex.
	Off Martha's Vineyard.		1881.	U. S. F. C.		
918	S. ½ W. 61 m. f. Gay Head.	45	July 16.	"	1 l.,	from fish.
919	" 65 "	51½	"	"	2 l.,	from Lophius.
923	" 78½ "	96	"	"	3	juv.
924	" 83½ "	110	"	"	5	juv.
925	" 86 "	224	"	"	1	juv.
939	S.byE.½E. 98 "	258	Aug. 4.	"	1 l.;	1 juv.
940	" 97 "	130	"	"	1 l.;	1 juv.
949	S.W. 79½ "	100	Aug. 23.	"	1 l.,	in Lopholatilus.
1025	S.S.W.¼W. 95 "	216	Sept. 8.	"	1 l.,	in fish.
1033	S.S.E.½E. 106 "	183	Sept 14.	"	1 l.,	in Merlucius.
1038	S.byE.¼E. 89½ "	146	Sept. 21.	"	1 l.	
	Newfoundland.	Surf'e	1880.	Osborn	3 l. ♂;	10 l. ♀.

Mr. H. L. Osborn, in the American Naturalist, vol. xv, p. 366, May, 1881, has given an account of the habits of this squid, at Newfoundland, and of the methods of capturing it there, for bait.

Enoploteuthis Cookii Owen. (See p. 241.)

Enoploteuthis Cookii Owen, Trans. Zool. Soc. London, xi, p. 150, pl. 30, figs. 1–3, pl. 31, figs. 1–4, pl. 32, figs. 1–6, pl. 33, fig. 1 (restoration). June, 1881.

Sepia unguiculata Molina, 1810 (no description).

Enoploteuthis Molinæ D'Orbigny, Ceph. Acétab., p. 339, 1845–1848.

? Enoploteuthis Hartingii Verrill, this vol., p. 241, pl. 24, figs. 4–4*b*, 1880.

Professor Owen has very recently described in detail and has given excellent figures of most of the existing parts of this large and remarkable cephalopod, which have so long been preserved and have so often been referred to, but hitherto have never been scientifically described. (See p. 241). It is to be regretted, however, that Professor Owen has neither described nor figured the teeth of the radula, in a manner to enable it to be used as a systematic character. His statement in regard to it is only of the most general kind, and shows only that there are seven rows of teeth. It is also a matter of surprise that he has not compared any of the described portions with the corresponding parts of an equally large and very closely allied *Enoploteuthis* carefully described and figured by Harting in 1861 (see p. 241), and to which I have given the well-merited name, *E. Hartingii.*

It is not improbable that the two forms are really identical, but this cannot be certainly determined from the figures, because the corresponding parts are not always represented in the same positions, and it is uncertain whether the corresponding arm is preserved in the two cases.

Harting figures, rather poorly, the teeth of the radula, which appear to be very peculiar, if his figure is correct (see my Pl. XXIV, fig. 4*b*).

The shape of the mandibles appears to be different in the two species, however, and the large hooks also differ in form.

Histioteuthis Collinsii Verrill. (pp. 234, 300).

The teeth of the odontophore, originally described and figured (p. 237, Pl. XXXVII, fig. 5), were not the most developed of those on the same odontophore. On the middle and best developed parts, the bases of the central and inner lateral teeth, when seen in a front view, are broader than indicated in the former figures, in which they are seen nearly in profile. The median tooth has a long, acute, central denticle, but no distinct lateral denticles, the broad, short base having the outer angles only slightly prominent, or not at all so; the inner lateral teeth are nearly as large, with one similar large denticle,

but the broad base is oblique, and the outer border is sloping, without a prominent angle.

The pedicels of the larger suckers on the tentacular club are very peculiar. They are, when extended, long and remarkably stout, their diameter being more than half that of the sucker. They are cylindrical, and are capable of being invaginated, toward the summit, so that they can be lengthened out or very much shortened by a sort of telescopic motion. The upper end is thick, and fits the basal part of the broad sucker like a piston. (Pl. LV, figs. 6, 6*a*.)

Two additional examples of this interesting species have been received. They are not in so good condition as the one originally described. The head and arms alone remain, but these are well enough preserved to show the characteristic color-marks. The first is considerably smaller than the specimen taken by Capt. Collins. It was taken from a cod, on the western part of the Grand Bank, N. F., by Capt. Johnson and crew, of the schooner "Augusta Johnson," (lot 962). Presented to the U. S. Fish Commission, June, 1881. The last specimen was taken in 180 fathoms, near the N. E. part of George's Bank, and presented to the U. S. Fish Commission by Capt. Chas. Anderson and crew, of the schooner "Alice G. Wonson," October, 1881, (lot 980).

Brachioteuthis, gen. nov.

Allied to *Chiroteuthis*. Differs in having the lateral connective cartilages of the siphon simple, long-ovate, and the corresponding cartilages of the mantle in the form of simple, linear ridges; a rhombic caudal fin; pen with a simple, linear, anterior portion, suddenly expanding into a much broader, lanceolate, posterior portion, which is naturally infolded; arms slender, the ventral ones not distinctly obliquely compressed; tentacular club without a spoon-like cavity at tip.

The siphon has a valve and dorsal bridle as in *Chiroteuthis*, and the suckers, so far as preserved, are similar, but those of the club are more numerous, and their pedicels apparently had a less prominent bulb below the sucker.

In addition to the following new type-species, this genus probably includes the *Chiroteuthis Bonplandii* Verany, from the eastern Atlantic.

B. Bonplandii, as figured, has a very similar pen, but the shape of the caudal fin is different, and the arms are more nearly equal in length. The arms are also represented as having small swellings at the tips. Its tentacular arms are not known.

Brachioteuthis Beanii, sp. nov.

Plate LV, figures 3–3*b*; Plate LVI, figures 2–2*a*.

Male: Body rather small, tapering backward to an acute posterior end; dorsal mantle-edge with a broad obtuse angle; caudal fin large in proportion to the body, broad rhomboidal; outer angles prominent, anterior to the middle: the anterior lobes project forward considerably beyond the insertions, and are rounded. The form of the fin is much like that of *Ommastrephes*. Head thickened at the bases of the arms, not so large in proportion to the body as in *C. lacertosa*. Eyes large, eye-lids thin. Siphon large, with two strong dorsal bridles; internal valve broad, rounded, somewhat back from the orifice; connective cartilages long-ovate, broadest behind (fig. 2*a*); dorsal cartilage of neck oblong, with a strong median ridge and two deep parallel grooves. Lateral cartilages of mantle (fig. 2) are simple linear ridges, extending to the edge of the mantle. Arms not very large, somewhat rounded, long and slender; the dorsal ones are much smaller and shorter than the others; two lateral pairs nearly equal in size and length, more than two-thirds the length of the mantle. Ventral arms shorter and much more slender than the lateral, more than half the length of the mantle; the ventral arms show but little of the compressed, oblique form, so conspicuous in the preceding species, and the crest or fold of skin along the outer-ventral angle is narrow, thin, and not very conspicuous; the suckers on the ventral arms are in two alternating, not distant, rows, often appearing almost as if in one row toward the base, where they become smaller, but are of the normal cup-shaped form, with finely denticulate rims and slender pedicels; the tips of both ventral arms are much injured, but small, normal, long-pediceled suckers can be traced to the tip of the left arm; the right arm is denuded of its skin and suckers at the tip. The suckers of the four lateral arms are in two rather close rows, larger, oblique, low cup-shaped, attached by slender pedicels, which are somewhat swollen just below the suckers; most of them have lost their horny rings; marginal membranes rudimentary. Web between the arms, rudimentary. Tentacular arms very long and slender, in alcohol about twice the length of the mantle; a few scattered, sessile suckers are found along the whole length of the arms; tentacular club well-developed, long-ovate, oblique, with a thick wrist and flat or concave sucker-bearing face; suckers small and very numerous, crowdedly arranged in many rows (probably sixteen rows or more), some of the middle ones larger than the rest;

suckers not well preserved, but all appear to have been alike in form; pedicels long and slender, with a smooth and not very large swelling below the base of the sucker; the suckers have lost their horny rims, but the sheaths are shaped much like those of *C. lacertosa*, the distal portion being hood-shaped, with a lateral opening, while the basal part is swollen laterally. The tip of the club is simple, without any such spoon-shaped appendage as is found in the preceding species. Buccal membrane large, with a free thin edge, which scarcely forms angles.

Pen (Pl. LV, fig. 3*a*) has a narrow, linear anterior portion, consisting of more than half its length, decreasing in width backward, then suddenly expanding into the posterior portion, which is broad and thin, and infolded, so as to form a large, compressed posterior cavity; the anterior portion is concave beneath, with no midrib, the edges excurved and slightly thickened; when spread out and flattened the posterior portion has a lanceolate form, rather abruptly widening anteriorly and very gradually tapering backward, with a double midrib, and some delicate lines parallel to it, while the lateral expansions are very thin and delicate. Color of body mostly destroyed, in the typical specimens, but small, light purplish brown chromatophores are uniformly scattered over the parts best preserved; this is also the case on the head, siphon, and outer surfaces of the arms, where the skin is well preserved; scattered spots also occur on the inner surfaces, between the suckers.

A larger specimen (station 994), which has lost its head and pen, and, therefore, cannot be positively identified, has a much darker color. It is dark purplish brown over the whole body.

The male has the mantle 62^{mm} long; length of caudal fin, 31; its breadth, 36; end of tail to base of arms, 85; length of dorsal arms, 26; of second pair, 48; of third pair, 45 + (tips gone); of fourth pair, 35; of tentacular arms, 118; of sucker-bearing portion of club, 16; breadth of tentacular arms, 2; of club, 4; of lateral arms, at base, 3·5; of ventral arms, 3; diameter of eye-ball, 8; of the largest suckers of lateral arms, 1·2; length of pen, 62; of anterior, narrow portion, 38; its breadth anteriorly, where widest, 2; where narrowest, 1·25; length of posterior portion, 24; its breadth, 8^{mm}.

The teeth of the odontophore (Pl. LV, fig. 3*b*) form seven rows; the median ones have a large, acute central, and two small, lateral denticles; the inner lateral teeth have a large, acute, inner denticle and a very small outer one; the next to the outer lateral teeth are somewhat stouter than the outermost, which are slender, strongly curved, and very acute; no marginal plates were observable.

The supposed female has lost the tail, but the arms are in better condition than those of the male; it differs from the male in having distinctly smaller suckers on the lateral arms. Length of dorsal arms, 27^{mm}; of second pair, 44; of third pair, 46; of fourth pair, 37; of tentacular arms, 120; of club, 16^{mm}.

Two typical specimens were obtained off Martha's Vineyard, at stations 1031 and 1033, in 255 and 183 fathoms; one of doubtful identity, at 994, in 368 fathoms, by the U. S. Fish Commission, in 1881. All three were from fish-stomachs.

I take pleasure in dedicating this interesting species to Dr. T. H. Bean, the ichthyologist, who took charge of the fishes on the "Fish Hawk," this season.

Chiroteuthis lacertosa, sp. nov. (See p. 299.)

Chiroteuthis Bonplandii ?, p. 299 (*non* Verany.)

PLATE LVI, FIGURES 1–1*f*.

A nearly complete male specimen of a *Chiroteuthis*, lacking only the tentacular arms and the distal portion of the left ventral arm, was received after the preceding pages were put in type. The stumps of the tentacular arms, remaining, bear the same kind of unarmed sessile suckers as did the arm described on p. 299, and figured on pl. 47, figs. 1–1*b*. It appears to be a new species, and is very distinct from *C. Bonplandii*. The sessile arms are very large in proportion to the head and body, and the ventral arms are much larger than any of the others. The body is small, obconic, tapering rapidly backward to the origin of the caudal fin, where it becomes very small, and continues to taper to the very slender posterior end. The median dorsal angle of the mantle-edge projects far forward, as a broad angular lobe; lateral angles rounded and not prominent. Caudal fin relatively large, as compared with the body, broad-ovate in outline, widest near the middle, tapering backward to an acuminate, slender tip; very broadly rounded laterally, narrowing abruptly anteriorly; the anterior lobes are small, rounded, and project only slightly forward beyond the insertions. Siphon large, with a well-formed valve, far back from the orifice; dorsal bridles rudimentary. Connective cartilages on the base of the siphon, broad-ovate, ear-shaped, with two rounded prominent lobes projecting into its concavity, one posterior, the other ventral, so that the pit is three-cornered (fig. 1*b*). The corresponding connective cartilages of the mantle consist of two pits, separated by a prominent, triangular tubercle (fig. 1*c*). Head large, in proportion to the body, tapering backward from the

bases of the arms. Eyes large; lids thin and simple, without a distinct lachrymal sinus. Behind and below each eye there is a long (4mm), slender, clavate, soft papilla (fig. 1*f*), probably olfactory in function.

The sessile arms are large and, except the ventral, unusually rounded; the inner sucker-bearing faces are much less differentiated than usual, scarcely differing from the other sides in color, and bordered by only a slight or rudimentary membrane on each side; the rounded prominences from which the sucker-pedicels arise are also colored and not much raised. The dorsal arms are rather long and tapering, but much shorter and smaller than the others, slightly compressed and with a slight median crest distally. The next pair are similar in form and structure, but considerably longer and larger. The third pair are much longer and larger, with the outer angles well rounded, and a strong median crest extends nearly to the base, but is wider distally, where the arms are strongly compressed. The ventral arms are considerably longer and stouter than the third pair, and very different from all the others in form; they are strongly compressed in the direction parallel with the median plane of the head, and have the lower and outer angles well rounded, and the sucker-bearing face wide and scarcely differentiated from the lateral faces; but on the superior lateral side there is a wide and thick crest running the whole length of the arms, giving them a strongly and obliquely compressed appearance. The suckers on the ventral arms are smaller, fewer, and more distant than on any of the others; those at the bases are largest and three or four stand nearly in a single row; farther out, along the middle of the arm, they are distantly arranged in two rows and rapidly become small. The left ventral arm shows no signs of being hectocotylized; the right one, however, has lost half its length by mutilation. On all the other arms the suckers are regularly and much more closely arranged in two rows, and decrease more gradually in size from near the base to the tips.

The suckers *on all the arms* are similar in form; they are rather deep, narrowed at the rim, slightly constricted above the middle, and swollen below, and very oblique at the base; the pedicels are slender and nearly laterally attached; the horny rims are very deep and oblique, and strongly denticulated on the outer or higher side, but on all the arms they are *smooth on the inner side;* the median, outer denticles are long, slender, close together; laterally they become shorter, broader, acute-triangular and curved forward. On the larger suckers the outer teeth are obtuse, but on the distal ones they become

more slender and acute. The margins of the suckers are surrounded with small, elongated scales. (Pl. LVI, figs. 1*d*, 1*e*.)

The buccal membrane is thin and much produced, with the angles little prominent; it is attached to the arms by eight thin, but wide, bridles, the two superior ones united together near their origin. The web between the arms is rudimentary but distinct. The pen (fig. 1*a*) is very unlike that of *C. Veranyi*, as figured and described by D'Orbigny. It has a long, narrow shaft of nearly uniform width, and a long posterior portion, a little wider than the shaft, corresponding in length to that of the caudal fin; at the commencement, this portion expands into narrrow, free, incurved margins, but these unite quickly so as to form a long, narrow, angular, tubular portion, tapering to a very slender tip; this portion (1*a''*) has a dorsal keel, with a groove each side of it, two dorsal angles and a ventral angle along each side; the narrow shaft has a dorsal keel, with the sides bent down abruptly, nearly at right-angles, and a little incurved, so as to produce a squarish keel above, with a deep angular groove below, while the very narrow margins bend outward abruptly (1*a'*); the shaft increases very slightly in width, to near the subacute anterior end, but preserves the same form, and there is no distinct dilation of the margin anteriorly, such as D'Orbigny figures in the pen of *C. Veranyi*, nor does the posterior portion resemble his figure, though if split open and flattened out, it would resemble it more nearly.

This specimen is an adult male, in the breeding condition, for its spermatophore-sac is much distended with spermatophores. The color is much like that of *C. Veranyi*. It is everywhere thickly specked with small, purplish brown chromatophores, except on the buccal membrane and the bases of the tentacular arms, where there are but few; the head around the eyes and the end of the siphon are darker; a row of very distinct, rather large, round, dark purple spots runs along the inner surface of the ventral arms, just outside of, and alternating with, the upper row of suckers, which they about equal in size.

Total length, to end of ventral arms, 383^{mm}; to end of third pair, 366^{mm}; to end of dorsal arms, 298^{mm}; tail to dorsal mantle edge, 125^{mm}; to base of dorsal arms, 178^{mm}; length of dorsal arms, 120^{mm}; of second pair, 150^{mm}; of third pair, 188^{mm}; of ventral, 205^{mm}; length of caudal fin, 60^{mm}; its greatest breadth, 41^{mm}; breadth of head at eyes, 20^{mm}; of dorsal arms, 7^{mm}; of third pair, 10^{mm}; of ventral arms, 13^{mm}; of bases of tentacular arms, 3^{mm}; diameter of largest suckers of lateral arms, $2{\cdot}25^{mm}$.

Brown's Bank, off Nova Scotia, taken from the stomach of a cod (lot 956). Presented to the U. S. Fish Commission by Capt. Wm. Dempsy and crew, of the schooner "Clara F. Friend," June, 1881.

The internal anatomy is somewhat peculiar in several respects, but will not be fully described in this place.

The gills are short and broad, with very long lamellæ. The reproductive organs occupy a large part of the visceral cavity. The testicle is a large, thick, broad-ovate organ, with the two sides folded together around and closely united to the large cœcal lobe of the stomach. The testicle does not extend back beyond the origin of the caudal fin, the visceral cavity being very narrow in that region. The prostate gland and vesiculæ seminales are large and swollen, and the spermatophore-sac is also large. The efferent duct is large and long, extending far forward; it expands at the end into a spade-like form, with an acute tip; its orifice is oblique ear-shaped, situated on one side, near the end, and is protected by a lobe or flap. The stomach is saccular and the large cœcal lobe is not very long. The liver is thick. The posterior aorta goes far back, nearly to the origin of the fin, before dividing, for the median septum of the branchial cavity is placed far back. The ink-sac has the ordinary pyriform shape.

A smaller, female specimen, probably belonging to this species, was taken by Captain Z. L. Tanner, on the "Fish Hawk," October 10, off Delaware Bay, in 435 fathoms, station 1048.

This specimen agrees nearly with the type specimen, described above, in the form and proportions of the body, head, arms, caudal fin, pen, etc., and in the structure and denticulation of the suckers. The caudal fin is slightly broader in proportion, while the suckers are deeper and relatively smaller, especially those on the ventral arms, which are decidedly smaller than those on the lateral ones. They are finely and sharply denticulated on the outer edge, as in the type.

The color is, however, quite different, for in this example the skin and flesh are translucent and beautifully specked with regular, round, often rather large, not crowded, dark brownish red chromatophores; the larger of these, especially on the under side of the fin and body, are ocellated; on the head and arms the chromatophores become smaller and more crowded, more nearly as in the type. The row of large dark purple spots, along the ventral arms, are, in this example, decidedly raised and wart-like. One of the tentacular arms is perfect. These are very long and slender, and bear, along their whole length, relatively large, rounded, wart-like, dark purple, sessile suckers, having a small central pit. These suckers are about two-

thirds as broad as the diameter of the arm, and from close to the base of the arm to the distal fourth they are separated by spaces mostly equal to about twice their diameter; distally they are less numerous. The tentacular club is well developed, with a broad marginal membrane along each side, having scalloped or notched edges. The club terminates in an ovate, subacute, dark purple, hollow organ, with its opening on the outer side of the arm. The suckers (Plate LV, fig. 5) are regularly arranged in four rows. The stalk is long, with a dark purple, fluted summit, surmounted by a very slender pedicel bearing the sucker, which is hooded, with a lateral opening; the horny ring bears several slender, sharp teeth on the outer side, the central one being much the longest;* the soft rim of the sucker is covered with many rows of small scales, the inner ones with acute tips. The lateral suckers do not alternate with the median, but the two arise close together, opposite each other, and in line with the teeth on the edge of the marginal membrane. The inner surface of the club is specked with brown chromatophores, and the marginal membranes are crossed by brown lines, corresponding to the notches in their edges.

Total length, to end of ventral arms, 194^{mm}; to end of third pair, 150; to end of dorsal arms, 127; tail to dorsal mantle edge, 59; to base of dorsal arms, 86; length of dorsal arms, 41; of second pair, 56; of third pair, 69; of ventral, 110; of tentacular arms, 180; of club, 17; breadth of club, 5; length of caudal fin, 27; its greatest breadth, 24; of dorsal arms, 4; of third pair, 5; of ventral arms, 8; of bases of tentacular arms, 1·5; diameter of largest suckers of lateral arms, 1.

This species differs widely from *C. Bonplandii* in the sessile arms, etc. It is much more nearly related to *C. Verranyi*, from which it differs decidedly in the pen; in the suckers; and in the caudal fin, if these parts are correctly described and figured, for the latter.

Desmoteuthis tenera, sp. nov.

PLATE LV, FIGURES 2–2*d*. PLATE LVI, FIGURE 3.

Two small, but perfect, specimens of this species were taken in the "trawl-wings"† this season, at station 952, in 388 fathoms.

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* The arm figured on Pl. XLVII, figs. 1–1*b*, does not agree with this, and may belong to a different species; but the difference in its suckers may be due to injury.

† The "trawl-wings," which were first invented and used by the U. S. Fish Commission, this summer, consist of fine nets attached to a support extending out from each end of the trawl-beam. When in use they are about two feet above the sea-bottom. They are provided with an interior funnel-shaped net to prevent the escape of animals captured. They have been of great value to us for capturing, and retaining in

The specimens are both males, but show no positive evidence of hectocotylization. The body is long, somewhat fusiform, slightly smaller in advance of the middle. The tissues are exceedingly thin, delicate, pale, and translucent, so that the pen and other organs can be seen through the mantle. Anteriorly the edge of the mantle is attached to the head, medially, by a muscular commissure, and there is *no free edge* (such as D'Orbigny figures in *T. pavo*) at the narrow middle portion of this band. This commissure is broader within the mantle, and there is another large, oblique, muscular commissure, extending forward to the edge of the mantle, on each side, extensively uniting the inner surface of the mantle to the sides of the siphon. These commissures leave only a rather narrow opening to the gill-cavity, on each side, and one small ventral one, and the interior ventral cavity is partitioned off from the lateral ones.

The siphon is large, projecting forward between the lower sides of the large eyes; it has no valve in the ordinary place, but toward the base, on the dorsal side, there are two erect, rounded, ear-like flaps, each with a small papilla (*i'*), and a rounded, valve-like, raised median fold and a central papilla (*i*) in front of them. (Pl. LV, fig. 2*d*.)

The caudal fin is comparatively small, narrow-ovate, tapering to a short, blunt posterior end, and with the anterior lobes narrowed and scarcely projecting beyond the insertions. The eyes are very large and prominent, occupying the whole of the sides of the head, wide apart dorsally, but nearly in contact beneath; eye-lids thin, entire.

Arms rounded, rather slender, tapering to slender tips; those of the third pair are much the longest, and like the second pair, bear along the distal half suckers much larger than the proximal ones; tips short, with few small suckers. The dorsal and ventral arms are about equal, and not much more than half as long as the third pair; they bear smaller suckers, in two rows, regularly decreasing distally. The second pair is intermediate in length between the 1st and 3d pairs, with two rows of larger suckers on the outer half, suddenly decreasing distally, with minute ones close to the tip. The large suckers (fig. 2*b*, *c*) on the second and third pairs of arms are much larger than the others,

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excellent condition, many kinds of free-swimming deep-sea animals, not otherwise obtainable, or if taken in the trawl, crushed by the great masses of fishes, echinoderms, actiniæ, etc., usually taken in every haul, in these waters.

Among the things captured in the "trawl-wings" are not only several cephalopods (including *Alloposus*, *Lestoteuthis*, *Rossia*), but *Cymbulia calceolus* and other Pteropods; vast numbers of *Sagitta*, one of them bright orange-colored; numerous species of Copepod crustacea, some of them of great size; Schizopods; Salpæ; Acalephs, including one very remarkable new form of Siphonophora, etc.

but similar in form, deep cup-shaped, convex in the middle, obliquely attached, with a smooth horny rim, except on the distal ones, which have blunt denticles externally. There are about sixteen of these suckers on each of the lateral arms, but eight or ten are decidedly larger than the rest. The large suckers commence nearly at the middle of the arms and extend to very near the tips. The suckers on all the arms are deep, urceolate, with somewhat contracted apertures; they mostly have the horny rim entire; the distal ones on the ventral arms are finely denticulated. The third pair of arms have a thin median carina on the outer side, along the distal third.

All the arms have a wide marginal or protective membrane along the inner edges, outside the suckers; these membranes are strengthened by transvere thickened, muscular processes, opposite each sucker; between these the membrane recedes so that the edge is scolloped. The ventral arms have also a membrane along the outer, ventral angle. I am unable to detect any positive signs of hectocotylization, either in the dorsal or ventral arms. Perhaps the presence of the very large suckers on the lateral arms may be a sexual character, but if so, they are symmetrical on the two sides.

The tentacular arms (Pl. LVI, fig. 3) taper from the thickened base, and in our specimens equal in size, and are not much longer than, those of the third pair; club well developed, rather broader than the rest of the arm, with a dorsal keel and wide, marginal, protective membranes; the suckers are arranged in four regular rows; the larger suckers are about equal in size to the larger ones of the dorsal arms; of these there are eight or nine in each row, the marginal ones are scarcely smaller than the median ones and similar in shape, but more oblique; all these suckers are cup-shaped, obliquely attached, with long pedicels; the marginal ring is denticulated all around, the teeth on the outer or higher side being slender, sharp and incurved; those on the inner side minute. The distal part of the club is short, and covered with four rows of small suckers, similar to the larger ones in shape and armature; at the tip is a small group of minute suckers, apparently unarmed. At the proximal end of the club there is a group of small denticulated suckers; and four irregular rows of minute, connective suckers, attached by short pedicels, extend along the inner surface of the arm to the middle or beyond; these are interspersed with minute tubercles, more distinct distally, near the club. The outer buccal membrane is narrow, without distinct angles.

The pen is very thin, delicate, pale yellow; the anterior portion is very narrow and slender; the posterior third, commencing opposite the

origin of the fins, is lanceolate, with two faint, close ribs along the middle, and less distinct parallel lines each side of these; the tip is an acute hollow cone, about 10^{mm} long.

Color of mantle, pale yellowish white, translucent, with scattered, conspicuous, round, or more or less elliptical, purplish brown spots, 2 to 3^{mm} in diameter, and 5 to 10^{mm} apart. Eyes dark purplish or chocolate-brown; head, siphon, and outer surfaces of arms thinly specked with purplish brown chromatophores.

The length of the largest specimen is 163^{mm}, from end of tail to tip of 3d pair of arms; length of mantle, dorsally, 116^{mm}; mantle to base of dorsal arms, 11^{mm}; diameter of eyes, 17^{mm}; breadth of head across eyes, 30^{mm}; breadth of body, 26^{mm}; length of caudal fin, 45^{mm}; its breadth, 28^{mm}; length of dorsal arms, 20^{mm}; of 2d pair, 25^{mm}; of 3d pair, 32^{mm}; of 4th pair, 20^{mm}; of tentacular arms, 35^{mm}; of club, 11^{mm}; breadth of lateral arms, at base, 3.5^{mm}; diameter of largest suckers, 2·5^{mm}.

The teeth of the odontophore (Pl. LV, fig. 2*a*) form seven rows, as usual; the median teeth have a very large and long median denticle and a small one at each lateral angle; the inner lateral teeth have a large inner denticle and a very small outer one; the two outer rows are rather stout; there is also a marginal row of small, more or less elliptical plates, with their outlines rather indefinite.

Off Martha's Vineyard, 87½ miles from Gay Head, station 952, in 388 fathoms. U. S. Fish Commission, Aug. 4, 1881.

This species resembles *Taonius pavo* (for which I at first mistook it) in form, but is very different in color and other characters. The suckers, which are remarkably flat in *T. pavo*, and strongly serrate, are in this very deep, and the edge of the ring is generally entire. The pen is also different.

Notes on the visceral anatomy.

Anatomically, this species closely resembles *Desmoteuthis hyperborea*. (See Pl. XXXIX, fig. 1.) It has a similar short, thick, compressed, ovate liver, with the intestine in a groove along its ventral edge, and the small ink-sac imbedded in its antero-ventral surface. The gills are laterally placed, short, with long lamellæ. The heart is small, irregularly tubular, oblique, with four angles or lobes where joined by the principal vessels. The efferent vessels from the gills are long and conspicuous, because the bases of the gills are distant from the heart. The alimentary tract consists of a short, narrow rectum, attached to the liver, and ending in a bilabiate aperture,

guarded by two slender papillæ; of a long, rather wide, tubular portion, extending back to the base of the caudal fin, and covered, along the ventral side, with lateral rows of clusters of small follicular glands, which, near the liver, diverge into two, separate, large, lateral clusters; posteriorly, where the rows of follicles cease, there is a small, firm, bean-shaped, glandular organ, lamellose within (? a gizzard); this is followed by a long tubular, or fusiform, more or less saccular stomach and cæcal appendage, running back nearly to the end of the body; a constriction at the origin of the cæcal appendage. The testicle is a rather small, slender, lanceolate organ, attached laterally, for its whole length, to the side of the cæcal appendage. The prostate gland and vesiculæ seminales have their usual position, at the base of the left gill, but they are small, and probably not fully developed; the efferent duct extends over and a short distance beyond the base of the gill, and is slender and pointed. The renal organs are very different from those of the common squids (*Loligo* and *Ommastrephes*). The posterior part of the anterior vena-cava becomes glandular in front of the heart; there it parts, sending a long, smooth vein to the base of each gill; there, each of these veins expands into an ovate renal organ, before joining the branchial auricles.

Family SEPIOLIDÆ (See p. 367.)

During the explorations made by the "Fish Hawk," the present season, we were fortunate in obtaining additional specimens, including both sexes, of the very interesting and beautiful species described by me in 1878, under the name of *Sepiola leucoptera*. These specimens have given me an opportunity to make dissections, which I had not done with the few specimens previously known. These studies show that it has no pen; that the presence of the remarkably enlarged suckers of the second pair of arms is not confined to the male; and that this species is the type of a very distinct genus, especially remarkable for being the only known genus, among *Myopsidæ*, that has round pupils and the eye-lids free all around. In fact, it shows quite conclusively that this division of the Decacera into two groups, based on the presence or absence of free eye-lids, is purely artificial and of little or no systematic value. Therefore the characters attributed to the family, *Sepiolidæ*, must be modified to a considerable extent, to include this genus.

In its internal anatomy this genus differs but little from *Sepiola*, *Heteroteuthis* and *Rossia*, notwithstanding its remarkable divergence in respect to the eyes and pen. Other genera of Sepiola-shaped

cephalopods agree with this in lacking a pen. Of such genera, Professor Steenstrup has recently [Vidensk. Selsk. Skr., 6 R., nat. math. Afd., i, 3, 1881, p. 213] described two: *Idiosepius* and *Sepiadarium*, both of which he associates with the Sepidæ, because the ventral arms are hectocotylized. One of these (*Idiosepius*) has the mantle free dorsally, as in *Rossia*, but with ovate connective cartilages on the sides; the other has a dorsal commissure, as in *Sepiola*, and lateral commissures, much as in *Taonius*. To me, these seem more nearly allied to *Loligo* than to *Sepia*. In addition to these, I have to add another genus,* from the Bay of Yeddo, Japan. Of this genus I have two species, collected by Prof. E. S. Morse.

Stoloteuthis Verrill, gen. nov.

Type, *Sepiola leucoptera* Verrill. (See p. 347.)

Body short and thick, well-rounded. Head large, united to mantle by a broad dorsal commissure. Eyes large; pupils round; eye-lids free all around. No pen. Mantle thick, extending farther forward

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* **Inioteuthis**, gen. nov. Body, lateral fins, and dorsal commissure of the mantle as in *Sepiola;* lateral connective cartilages of the siphon, oblong-elliptical, with the groove open behind, fitting a linear ridge on each side of the mantle. Eye-lids free below, adherent above. Pen absent. Arms webbed only slightly, at base; suckers, both on sessile arms and tentacles, as in *Rossia*. Left dorsal arm hectocotylized somewhat as in *Sepiola Rondeleti* (see description by Steenstrup), but more extensively, with a large, prominent, fleshy, concave, ear-like structure, near the base, extending across the inner surface of the arm, and replacing both rows of suckers, their pedicels becoming confluent with the marginal membrane.

The outer side of this organ is divided by a median notch into two lobes; the distal one enclosing a large papilla, apparently formed of two confluent and modified sucker-pedicels.

Inioteuthis Japonica V. This small species has the suckers in two rows on all the arms. It appears to be the *Sepiola Japonica* D'Orbigny. The suckers of all the arms, but especially those of the dorsal and upper lateral arms, are much larger in the male than in the female. Tentacular club narrow, with small suckers, in about eight rows. The fins are small, nearly semicircular.

Inioteuthis Morsei V., sp. nov. This is easily distinguished from the preceding by the presence of four crowded rows of suckers on all the arms; the suckers are attached by slender pedicels, which arise from the top of prominent, thickened, basal stems. The tentacular clubs are well-developed, with exceedingly numerous, very minute suckers, in more than sixteen rows. Fins large, situated in advance of the middle of the body. Dorsal and ventral arms about equal; two lateral pairs longer, the third pair slightly longer than the second. Mantle edge, beneath, with a large emargination; dorsal commissure broad.

No males of this species are in the collection; therefore I refer it to this genus only provisionally. It has no pen.

beneath than laterally. Fins large, lateral. Siphon with an internal valve, in both sexes; connective cartilages oblong, with a central groove, fitting a linear ridge, on each side of the mantle; these do not extend to the edge of the mantle. Arms webbed for more than half their length, except between the ventral arms; second pair, in the male, and some females, with two or three much enlarged suckers near the middle. The suckers of all the arms are relatively larger in the male than in the female; dorsal arms of the male alike; their basal suckers are larger and more crowded than in the female; no other evidence of hectocotylization could be found.

Stoloteuthis leucoptera Verrill.

Sepiola leucoptera Verrill. (See p. 347.)

The largest specimen hitherto observed is an adult male, from station 947, in 312 fathoms. This differs but very little from the smaller male already described and figured (p. 348, Pl. XXXI, fig. 5), but it has, on the tips of both ventral arms, four rows of small suckers, while all the others, of both sexes, have but two rows, even to the extreme tips. The suckers on all the arms of this specimen are decidedly larger in proportion than on the females of nearly equal size, and the group of larger suckers on the second pair of arms is represented by one very large one, on each arm. More than half the female specimens also have the corresponding suckers much enlarged, but perhaps not so much so as the males. The large males appear to show some evidence of hectocotylization, in having the suckers near the base of both dorsal arms larger and more crowded than they are in the females, and the portions of the web bordering these arms appear to be somewhat thickened or swollen, a feature not present in the females. But I could detect no difference in the structure of the two dorsal arms, nor in the two ventrals. The tentacular arms are much swollen at base, especially the right one, while the club is narrower than the average width of the arm; just at the base of the club, along the upper edge of the 'wrist' there is a prominent free lobe or crest.

In alcohol, the integument appears very thick and rather soft. In life there appears to be a thick, gelatinous, transparent layer, outside the stratum containing the chromatophores.

The large male described above, in alcohol, is 40^{mm} long, from end of body to tip of lateral arms; breadth of body, 22; breadth of head, 20; breadth across extended fins, 38; length of lateral arms, from beak, 15^{mm}.

Stoloteuthis leucoptera.—Additional specimens examined.

Station.	Locality.	Fathom	When collected.	Received from.	Specimens. No. Sex.
947	Off Martha's Vineyard	312	Aug. 9, 1881	U. S. F. C.	1 l. ♂ : 1 j.
952	" "	388	" 24, 1881	"	1 l. ♀
998	" "	302	Sept. 8, 1881	"	2 ♀
999	" "	266	" "	"	1 ♀
1026	" "	182	" "	"	3 j.

Rossia sublevis Verrill. (See p. 354.)

This species was dredged by the U. S. Fish Commission, in considerable numbers, during the season of 1881, off Martha's Vineyard, in 153 to 458 fathoms. The eggs were taken in August and September, containing large embryos. These eggs were laid in the oscules of sponges, and are scarcely distinguishable from those of *R. Hyatti.*

Rossia sublevis.—Additional specimens.

Station.	Locality.	Fath.	Date.	Rec'd from.	Specimens. No. Sex.
	Off Martha's Vineyard.		1881		
924	S. ¼ W. 83½ m. from Gay Head,	160	July 16	U. S. F. C.	11. ♀ :eggs
925	S. ½ W. 86 m. from Gay Head,	224		"	21. ♂
939	S. by E. ½ E. 98 m. from Gay Head,	258	Aug. 4	"	19 : eggs.
943	S.S.W. 83 m. from Gay Head,	153	" 9	"	1
945	S. by W. ¾ W. 84½ m. from Gay Head.	202	"	"	11. ♂ : 4 ♀
946	S. by W. ¾ W. 87½ m from Gay Head,	241	"	"	2 ♂ : 3 ♀
947	S. by W. ¾ W. 89 m. from Gay Head,	312	"	"	6
951	S. 85 m. from Gay Head,	219	" 23	"	5 ♂ : 2 ♀
952	S. ¼ E. 87½ m. from Gay Head,	388	"	"	2 ♀
997	S.S.W. ¼ W. 103½ m. from Gay Head,	335	Sept. 8	"	1 ♂ : eggs.
1025	S.S.W. ¼ W. 95 m. from Gay Head,	216	"	"	3 ♀
1026	S.S.W. ¼ W. 93½ m. from Gay Head,	182	"	"	2 ♀
1028	S.S.E. ¾ E. 108½ m. from Gay Head,	410	" 14	"	1 l. ♂
1029	S.S.E. ¾ E. 109½ m. from Gay Head,	458	"	"	1 j.
1032	S.S.E. ½ E. 107 m. from Gay Head,	208	"	"	5
1033	S.S.E. ½ E. 106 m. from Gay Head,	183	"	"	1 j.: eggs.
1045	Off Delaware Bay,	312	Oct. 10	"	3 l. ♂ : 1 j.

Heteroteuthis tenera Verrill. (See p. 357.)

During the dredging season of 1881, this species was again taken in many localities, off Martha's Vineyard, in 45 to 182 fathoms.

The eggs of this species, containing, in some instances, embryos so far developed as to permit specific determination, have been taken in many localities, in 65 to 130 fathoms, by the U. S. Fish Commission, in August and September, associated with the adults. These eggs were particularly abundant at stations 865–867, 872, 873, 874, in 1880; and at stations 922, 940, 949, in 1881. Some of those taken in August are nearly ready to hatch, while others, taken as late as September, are freshly laid. The eggs are directly and firmly

attached to the surface of various objects, such as dead shells (of *Pecten*, etc.), annelid tubes, hydroids, fragments of Echini, ascidians, etc. They are placed near together, or side by side, so as to form larger or smaller groups. They are pearly white, about 3mm in diameter, nearly round, except that the attached side is somewhat flattened, and the upper surface has a small, conical process in the middle.

Heteroteuthis tenera.—Additional specimens.

Station.	Locality.	Fath.	Date.	Rec'd from.	Specimens. No. Sex.
	Off Martha's Vineyard.		1881		
918	S. ½ W. 61 m. from Gay Head,	45	July 16	U. S. F. C.	1 ♂ : 1 ♀
919	S. ½ W. 65 m. from Gay Head,	51½	"	"	4 ♂
920	S. ½ W. 68½ m. from Gay Head,	61	"	"	3 ♂ : 5 ♀
921	S. ½ W. 73 m. from Gay Head,	65	"	"	6 ♂ : 6 ♀
922	S. ½ W. 77 m. from Gay Head,	69	"	"	1 ♀ : eggs.
940	S. by E. ½ E. 97 m. from Gay Head,	130	Aug. 4	"	1 ♀ : eggs.
944	S.S.W. 82 m from Gay Head,	124	" 9	"	1 ♂ : 1 ♀
949	S. 79½ m. from Gay Head,	100	" 23	"	1 : eggs.
950	S. 75 m. from Gay Head,	69	"	"	1 ♂ : 2 ♀
1026	S.S.W. ¼ W. 93½ m. from Gay Head,	182	Sept. 8	"	1 ♂
1027	S.S.E. ¾ E. 105½ m. from Gay Head,	93	" 14	"	1 ♂
1038	N. lat. 39° 59′; W. long. 70° 06′,	146	" 21	"	5 ♂ : 2 ♀
1043	N. lat. 38° 39′; W. long. 73° 11′,	130	Oct. 10	"	1 ♂

Argonauta argo Linné (p. 364.)

In the American Naturalist, xv, p. 908, another specimen of this species is reported by Rev. Samuel Lockwood to have occurred at Long Branch, N. J., September, 1881. The shell is stated to have been fresh. This is the third specimen obtained on the coast of New Jersey, since 1876.

Alloposus mollis Verrill. (See p. 366.)

Octopus (?) sp.. Verrill, Bulletin Mus. Comp. Zool., viii, p. 109, pl. 4, fig. 3, 1881.

Plate L. Plate LI, figures 3, 4.

Two very large females of this species were taken by the U. S. Fish Commission, this season, off Newport, R. I. One was from station 937, in 506 fathoms, the other from 994, in 368 fathoms.

They were nearly equal in size. The weight of the first, when fresh, was found to be over 20 pounds. Length from the posterior end of the body to the tips of the dorsal arms 787mm (31 inches); to tips of 2d pair, 812mm (32 inches); to tips of 3d and 4th pairs, 711mm (28 inches); length of mantle, beneath, 178mm (7 inches); beak to tips of 3d pair of arms, 559mm (22 inches); breadth of body, 216mm (8·5 inches); breadth of head, 280mm (11 inches); diameter of eyes, 64mm (2·5

inches); of largest suckers, 10mm (·38 of an inch). It was measured while living.

The body, when living, was short and broad, and so soft and gelatinous that, when out of water, it could not retain its natural form. When placed in a large pan, it flattened out and filled up the vessel, like a mass of rather stiff jelly. Color, in life, pale bluish white, speckled with rusty orange-brown chromatophores; inner surfaces of arms dark purplish brown; suckers white.

Two detached and somewhat mutilated arms, with portions of a third arm and of the basal web, of a large specimen, formerly described by me as *Octopus ?* sp., but which I now refer to this species, were taken by Mr. Agassiz, on the "Blake," in 1880, at station 336, N. lat. 38° 21′ 50″, W. long. 73° 32′, in 197 fathoms.

The largest of these arms is 420mm long and 36mm broad. The suckers are large, prominent, subglobular, with a contracted aperture, and having a thin membrane around the outer margin. They form two alternating, rather distant rows, except near the base, where several that are somewhat smaller than those farther out, stand nearly in one row, with wide spaces between them. Diameter of largest suckers, 9 to 11mm; distance between their centers, 20 to 35mm. Color, dark purple. (Pl. LI, fig. 3.)

Smaller specimens were taken by us, this season, off Martha's Vineyard, in 310 to 715 fathoms; stations 938, 952, 953.

Alloposus mollis.—Additional specimens.

Station.	Locality.	Fath.	Date.	Rec'd from.	Specimens. No.	Sex.
	Off Delaware Bay.					
336	38° 21′ 50″; 73° 32′,	197	1880	Blake Ex.	1	l. frag.
	Off Martha's Vineyard.		1881			
937	S. by E. ½ E. 102 m. from Gay Head,	506	Aug. 4	U. S. F. C.	1	l. ♀
938	S. by E. ½ E. 100 m. from Gay Head,	310	"	"	1	j.
952	S. ½ E. 87½ m. from Gay Head,	388	" 23	"	1	j.
953	S. ½ E. 91½ m. from Gay Head,	715	"	"	1	j. ♀
994	S.S.W. ¼ W. 104½ m. from Gay Head,	368	Sept. 8	"	1	l. ♀

Octopus Bairdii Verrill. (See p. 368.)

Numerous additional specimens of this species were dredged off Martha's Vineyard, in 120 to 410 fathoms, by the U. S. Fish Commission, this season.

Octopus Bairdii.—Additional specimens.

Station.	Locality.	Fath.	Bottom.	Date.	Specimens. No.	Sex.
	Off Martha's Vineyard.			1881		
925	S. ½ W. 86 m. from Gay Head,	224	sand, mud	July 16	1 l.	♀ : 3 j. ♂
939	S. by E. ½ E. 98 m. from Gay Head,	258	"	Aug. 4	1 ♂ : 1 ♀ : 1 j.	
945	S. by W. ¾ W. 84½ m. from Gay Head,	202	"	" 9	3 ♀ : 1 ♂	
946	S. by W. ¾ W. 87½ m. from Gay Head,	241	"	"	4 ♀ : 5 ♂ ; 2 j.	
947	S. by W. ¾ W. 89 m. from Gay Head,	312	"	"	1 l. ♀ : 4 ♂	
951	S. 85 m. from Gay Head,	219	mud	" 23	4 ♀ : 2 ♂	
952	S. ¼ E. 87½ m. from Gay Head,	388	sand, mud	"	4 ♀ : 2 ♂	
994	S.S.W. ¼ W. 104½ m. from Gay Head,	368	mud	Sept. 8	1 l. ♂	
997	S.S.W. ¼ W. 103½ m. from Gay Head,	235	"	"	1 j. ♂	
998	S.S.W. ¼ W. 102½ m. from Gay Head,	302	"	"	1 ♂ : 1 ♀	
1025	S.S.W. ¼ W. 95 m. from Gay Head,	216	"	"	4 j.	
1026	S.S.W. ¼ W. 93½ m. from Gay Head,	182	"	"	1 l. ♂ : 1 l. ♀	
1028	S.S.E. ¾ E. 108½ m. from Gay Head,	410	"	" 14	1 ♂	
1033	S.S.E. ½ E. 106 m. from Gay Head,	183	sd., gravel	"	1 ♂	
1035	S.S.E. ½ E. 103½ m. from Gay Head,	120	sand	"	1 l. ♂	
1045	Off Delaware Bay,	312	mud	Oct. 10	1 l. ♂	
1047	Off Delaware Bay,	156	sand	"	1 ♀	

Architeuthis Harveyi Verrill. (No. 27).

After the preceding pages were put in type, another specimen of *Architeuthis* was secured.

This was found dead, floating at the surface, near the shore, at Portugal Cove, a few miles from St. John's, Newfoundland, November 10, 1881. It was obtained by Mr. Morris, who had a photograph of it made by Mr. E. Lyons, of St. John's, and then shipped it to New York, packed in ice, by the steamer "Catima," Capt. Davies. Mr. Morris has given a brief description of this specimen in an article in the New York Herald of Nov. 25, 1881. In Harper's Weekly of Dec. 10, accompanying an article on the same subject, apparently by the same writer, there is a wood-cut, apparently copied from the photograph.*

The specimen was purchased by Mr. E. M. Worth, and preserved, in alcohol, at his museum, 101 Bowery, N. Y., where I had a good opportunity to examine it about two weeks after it had been put in alcohol.

Although this is more nearly complete than any specimen hitherto brought to this country, the arms and suckers are not so well preserved, as in some of the other examples. All the sessile arms have lost more or less of their tips, so that the actual length cannot be given, and many of their suckers are either injured or lost; the

* This figure, though poor, gives a fair idea of the general appearance of the creature as it would look if lying flabby and collapsed on the shore. The peculiar appearance of the caudal fin was due to mutilation of that organ.

tentacular arms are also injured and most of the large suckers of the clubs are destroyed; the caudal fin was not only torn by handling, but one-half of it had, apparently, been destroyed and the wound healed before the death of the creature,* so that its true form cannot be determined; the eye-balls were burst; and most of the pen was gone.

The head, eye-lids, siphon, and front edge of the mantle are, however, in fair condition, and as these parts have not been well preserved in any of the previous examples, some new and valuable facts were learned in regard to the structure of those parts. Many of the following characters are of generic value.

The eye-lids were large, not much thickened, and only slightly angulated, and with a shallow sinus; diameter of opening 120^{mm} (4·5 to 5 inches). The transverse nuchal crests, behind the eyes, are distinct, but only slightly elevated; of the longitudinal ones only one, on each side, is distinct but is short and not very high, the others (unless they had been rubbed off) are rudimentary. The siphon is large and broad; aperture 102^{mm} (4 inches) broad, slightly bilabiate, with a broad valve within; dorsal bridles moderately developed. Siphon-pit shallow, *smooth*. Connective cartilages on base of the siphon simple, long-ovate, slightly oblique, and only a little concave. Connective cartilages on the sides of the mantle, short and close to the front edge, very simple, consisting of a simple, slightly raised, longitudinal ridge. The dorsal angle of the mantle-edge extends considerably forward, as an obtuse angle; the lateral angles are also distinct. The body is large and broad in the middle and anteriorly, but tapers very rapidly to the base of the caudal fin, which is relatively small.

This specimen, when examined by me, measured as follows: length of mantle to lateral angles of the front edge, 4·16 feet; from edge of mantle to anterior base of ventral arms, 1·25 feet; circumference of body, 4 feet; length of caudal fin, tip to end of lobe, 1·75; breadth of one-half, measured from median line, 8 inches; length of tentacular arms, 15 feet; of the club, 2 feet; from first of the large suckers to tip, 1·67 feet; length of ventral arms (minus tips), 4·66 feet; their circumference at base, 8·5 inches; length of the dorsal arms (minus tips), 4·5 feet; their circumference at base, 7·5 inches; circumference of 2d pair of arms, at base, 7·5 inches; of 3d pair, 8·5 inches; diame-

* Owing to this fact, which was not understood by those who saw and figured it, at first, some of the cuts that have been printed give the tail very peculiar and remarkable forms.

ter of largest suckers of sessile arms, ·75 inch. The arms appear very stout, especially at base, and not very unequal in size. In form they agree well with those already described from previous examples. The ventral arms have the inner face broader than on the other arms, and the two crests along the outer angles are well developed. The suckers, so far as preserved, have the same characters as in the former examples; the more proximal of those on the ventral arms are closer together in a longitudinal direction, but the rows are farther apart than on the other arms. The mandibles are dark brown, the tooth on the anterior alar edge of the lower mandible is large and prominent.

The color, which is partially preserved, especially on the arms and on the ventral surface of the body, agrees pretty nearly with that of *Ommastrephes*, consisting of small purplish brown chromatophores, more or less thickly scattered over the surface. The back had a bleached appearance, as if the creature had laid upon the shore or floated at the surface, with the back exposed, for some time after death.

Owing to the mutilation of the tips of the ventral arms, hectocotylization could not have been detected, if it had originally existed. The sex, therefore, could not be determined without cutting open the mantle. By everting the edge of the mantle, as far as possible, I could see, owing to insufficient light, only the tips of the gills, which are situated rather far back, but the reproductive organs could not be seen.

Conspectus of the Families, Genera and Species of Cephalopoda, included in this paper.

In the following synopsis the species that have actually been proved to belong to the fauna of the northeastern coast of America, or the waters adjacent, are numbered serially. They have all been personally studied by me, except *Taonius pavo.*

Subclass DIBRANCHIATA.

Cryptodibranchiata Blainville, Dict. Sci. Nat., vol. xxxii, p. 172, 1824.
Acétabulifères Férus. & D'Orb., 1835; Céphal. Acétab., pp. v, xxxv, 1.
D'Orbigny, Hist. Cuba, Moll., p. 5, 1853.
Dibranchiata Owen, Trans. Zool. Soc. London, vol. ii, p. 103, 1838.
Antepedia Gray, Catal. Brit. Mus.. Moll., vol. i, p. 3, 1849.

Branchial cavity large, containing a single pair of large, highly specialized gills, each having a muscular branchial heart at its base. Mantle very muscular. Siphon completely tubular, with or without an internal valve, and used in locomotion. The interior lateral or basal lobes of the siphon are flexible, and capable of acting as valves to close the opening of the branchial sac by pressing against the inside of the mantle when it contracts. The jet of water, thus forced through the siphon, by its reaction propels the animal backward or forward, or in any direction opposite to that in which its flexible extremity may be turned.

The body varies in form from subspherical to long-conical; sides often with fins. Mantle destitute of an external shell. The internal shell, when present, is dorsal, and may be either horny or calcareous. Sessile arms in four pairs, around the head, provided, on the inner surface, with suckers or with hooks (modified suckers). Eyes highly developed. Mouth with a sharp, horny beak, the upper jaw shutting into the lower one; mandibles hollow, supported by strong internal cartilages. Odontophore with seven (or rarely five) rows of sharp teeth. An ink-sac, which opens near the end of the intestine, at the base of the siphon.

This subclass includes two very natural divisions:

Decacera.—Having, inside the circle of eight sessile arms, two long tentacular arms, with suckers or hooks on the distal portion. Suckers

pediceled, with horny rims. Body usually elongated, always with lateral fins.*

Octopoda.—Having only the eight sessile arms. Suckers not pediceled, destitute of horny rings. Body usually short, obtuse, rarely finned.

Order I.—DECACERA.

Decapoda Leach, Zool. Miscel., vol. iii, 1817 (t. Gray) [*non* Latr., 1806].
H. & A. Adams, Genera, vol. i, p. 25.
D'Orbigny, Tabl. Méth. des Cephal., p. 57, 1826; Hist. Cuba, Moll., p. 30, 1853.
Decacera Blainville, Dict. Sci. Nat., vol. xxii, 1824; Man. Mal., p. 366, 1825.
Sephinia Gray, Catal. Brit. Mus., Moll., vol. i, p. 35, 1849.

Body generally rounded and elongated, often acute posteriorly. Ten prehensile arms, bearing suckers or hooks, which are *pediceled.* Four pairs of these, called sessile arms, are tapered from the base and covered with rows of suckers along the whole length of the inner face; the fifth pair of arms, known as tentacular arms, differ from the rest, and arise from a pair of pits or pouches, situated between and inside the bases of the third and fourth pairs of sessile arms; they have a more or less slender and contractile pedunculer portion and a distal, usually enlarged, sucker-bearing portion. Beak protractile, surrounded by an inner, and a loose outer buccal membrane, the latter usually with seven or eight angles, united to the arms by membranes. Eyes movable in the sockets, with or without lids. Head united to the mantle either by a dorsal commissure and two lateral, free, connective cartilages; by three free connective cartilages; or by three muscular commissures. Mantle usually supported by an internal, dorsal, horny 'pen,' or by a calcareous, internal, dorsal shell or 'bone;' sometimes the pen is absent; always with muscular fins on each side. Male, when adult, usually with one or two of the arms hectocotylized.

This group was divided by D'Orbigny into the following two tribes, which are more convenient than natural:

Oigopsidæ.—Eyes naked in front, furnished with free lids, with or without an anterior sinus; pupils round.

Myopsidæ.—Eyes usually covered by transparent skin, sometimes with a thickened fold, forming a lower lid, but in *Stoloteuthis* the lids are entirely free; pupils crescent-shaped, rarely round.

* The name *Decacera*, though not in so general use as *Decapoda* for this group, is retained because the latter was previously, and still is, in use for a group of Crustacea, and, therefore, cannot properly be used for these Cephalopoda.

OIGOPSIDÆ.

The division called *Oigopsidæ* includes two very diverse groups, differing very widely in their visceral anatomy, as well as in the structure of the eyes, siphon, and mantle connections. These may be called *Teuthidea* and *Taonidea.*

The former will include all the Oigopsidæ described in this paper except the *Desmoteuthidæ.* The *Taonidea* will include our *Desmoteuthidæ*, and also several allied forms, which have usually been carelessly referred to *Loligopsis.*

TEUTHIDEA Verrill.

Eyes with free lids, not stalked. Siphon with a subterminal valve. Mantle attached to the siphon by free connective cartilages. Stomach large, pouch-like; intestine short; liver very large; ink-sacs large. Pen horny, well developed, as long as the mantle. One of the ventral arms is usually hectocotylized in the male. Arms with suckers, or with claws, or with both.

Family TEUTHIDÆ Owen (restricted.)

Teuthidæ (*pars*) Owen, Trans. Zool. Soc. London, vol. ii, 1838.

Teuthidæ (*pars*) D'Orbigny, Céphal. Acétab., p. xxxvii (Introduction), p. 328, 1835–1848.

Onychoteuthidæ (*pars*) Gray, Catal. Brit. Mus., Moll., vol. i, p. 45, 1849.
H. & A. Adams, Genera, vol. i. p. 30.

Tentacular arms furnished with sharp, horny claws or hooks, which correspond with peculiarly and highly modified sucker-rings; true denticulated suckers usually accompany the hooks; tip of arm with a cluster of small suckers; proximal part of club usually with a mixed group of connective tubercles and smooth-rimmed suckers, by which the arms can be fastened together and used in concert. Sessile arms with hooks, with suckers, or with both. Eyes with free lids and a sinus. Mantle united to neck by three simple, movable, connective cartilages. Siphon with a valve and with dorsal bridles. Nuchal or olfactory crests well developed. Pen thin, usually lanceolate, generally with a posterior hooded portion, or hollow cone, and sometimes terminated by a solid cartilaginous cone. Hectocotylized arm not observed.

For a brief synopsis of the previously known genera of this family,* see pp. 250, 251.

Owen's family, *Teuthidæ*, included nearly all the *Decacera* having horny internal shells. As adopted by D'Orbigny, it included our *Ommastrephidæ* and *Teuthidæ*.

Enoploteuthis (See pp. 251, 404).

Enoploteuthis Hartingii Verrill. (pp. 240, 241, 404).

Enoploteuthis Molinæ D'Orb.=**E. Cookii** Owen. (pp. 241, 404).

Moroteuthis Verrill. (See p. 393).

Moroteuthis robusta (Dall) Verrill. (pp. 246, 393).

Gonatus Gray. (See pp. 290, 387, 390).

Gonatus amœnus Gray. (pp. 291, 388, 390).

Lestoteuthis Verrill. (See pp. 250, 387, 390).

1. **Lestoteuthis Fabricii** (Licht.) Verrill (pp. 291, 293, 387–390).

Family OMMASTREPHIDÆ.

Teuthidæ (*pars*) D'Orbig., Céphal. Acétab., pp. xxxvii, 328.
Onychoteuthidæ (*pars*) Gray, Catal. Brit. Mus., Moll., vol. i. p. 45, 1849.
Ommastrephidæ Gill, Classification Mollusca, p. 1, 1871.
Tryon, Man. Conch., vol. i, p. 107, 1879.

Body elongated, often very large (*Architeuthis*), tapering to a point posteriorly, shorter and less acute in the female. Sessile and tentacular arms without hooks, but provided with suckers, having denticulated, horny rings; tentacular arms with an expanded club, having four rows of suckers on its middle portion, those in the two central rows larger; proximal portion with or without smooth-rimmed connective suckers and tubercles; tip with a cluster of smooth-rimmed suckers. Siphon in a deep groove, attached by four bridles; an internal valve. Eye-lids with a distinct anterior sinus. Nuchal and olfactory crests consist of three longitudinal membranes on each side, united by a transverse one in front. Connective cartilages of the mantle

* The genus *Dosidicus* Steenst., should not have been there included. It belongs to the *Ommastrephidæ*, and is very closely related to *Sthenoteuthis*. The tentacular club bears denticulated suckers and the terminal cone of the pen is hollow.

Ancistroteuthis Krohnii appears to belong to *Onychoteuthis*. *Gonatus* and *Lestoteuthis* have since been restricted and their characters revised. (See pp. 388–394).

three; the lateral ones are usually T-shaped, formed by a longitudinal ridge, with a smaller transverse one across its posterior end; the corresponding cartilages on the siphon are long-triangular, with a longitudinal and a transverse groove. Two oviducts. Hectocotylized arm of the male may be either the right or left ventral.

Pen usually very narrow along the middle portion, and with three ribs; anterior and posterior portions expanded, the latter with the edges involute, and forming a terminal hood or hollow cone.

Ommastrephes (See pp. 267, 385).

Ommastrephes (*pars*) D'Orbigny, Voy. Am. Mérid., 1835; Céphal. Acétab., p. 341.

Illex and *Todarodes* Steenstrup, Oversigt k. Danske Videnske. Selsk. Forhand., 1880, p. 90.

2. Ommastrephes illecebrosus (Les.) Verrill. (pp. 268, 403).

Sthenoteuthis Verrill. (See pp. 222, 286, 385, 402).

Ommastrephes (*pars*) D'Orbigny, Voy. Amér. Mérid., Moll., (1835?); Céphal. Acétab., 1839–'48.

Sthenoteuthis Verrill, Trans. Conn. Acad., vol. v, p. 222, Feb., 1880; Amer. Journ. Sci., vol. xix, p. 289, April, 1880.

Ommastrephes Steenstrup, Oversigt k. Danske Vidensk. Selsk. Forhandl., 1880, p. 89 (sep. cop. p. 19, received Aug., 1880).

3. Sthenoteuthis megaptera Verrill. (pp. 223, 286).

Sthenoteuthis pteropus (Steenst.) Verrill. (pp. 228, 402).

4. Sthenoteuthis Bartramii (Les.) Verrill. (p. 288).

Architeuthis (Steenst.) Harting, 1881. (See pp. 197, 259, 394, 422).

Architeuthus Steenst., 1856, (no description).

5. Architeuthis Harveyi Verrill. (pp. 177–210, 259, 395, 422).

6. Architeuthis princeps Verrill. (pp. 181–189, 194, 259).

Architeuthis monachus (Steenst.) (pp. 238–245).

Architeuthis dux (Steenst.) Gervais. (pp. 238–240).

Architeuthis Hartingii Verrill. (p. 240).

Architeuthis Bouyeri Verrill. (p. 243).

Architeuthis (?) Mouchezi Vélain. (pp. 243, 398).

Architeuthis grandis (Owen) Verrill. (p. 400).

The number of the foreign species, mostly nominal and imperfectly known, will undoubtedly be much reduced when they become better known. Probably *A. dux* and *A. Bouyeri* are identical, but there is as yet no proper zoological description of either. The former has been very briefly described by Gervais, and Harting has published an outline figure of one of the mandibles.

Family MASTIGOTEUTHIDÆ, nov.

Body slender, pointed behind. Caudal fin large, rhombic. Mantle united to neck by three movable cartilages. Siphon with an internal valve and one pair of dorsal bridles. Eyes large, not prominent; lids free, simple. Buccal membrane 6-angled, without suckers. Arms free; suckers in two rows. Tentacular arms (in the typical species) not expanded into a club, the terminal portion round, tapering, covered with a multitude of minute suckers, in many rows. Neither auditory nor olfactory crests. Pen narrow, with a long, hollow posterior cone.

This family differs from *Ommastrephidæ* in lacking a distinct lachrymal sinus and olfactory frills, in the remarkable character of the tentacular arms, and in the simple connective cartilages.

Mastigoteuthis Verrill. (See p. 296).

7. Mastigoteuthis Agassizii Verrill. (p. 297).

Family CHIROTEUTHIDÆ Gray, (restricted).

Loligopsidæ (*pars*) D'Orb., Céphal. Acétab., p. 320, 1835–48.
Chiroteuthidæ (*pars*) Gray, Brit. Mus. Catal., Moll., vol. i, p. 42, 1849.

Body small; mantle with three movable connective cartilages. Eyes not prominent, with free, simple lids; no sinus. Siphon small, with an internal valve; no dorsal bridle. Olfactory crests absent. Buccal membrane seven-angled, without suckers. Buccal aquiferous openings six. Sessile arms large; web rudimentary; suckers with toothed horny rings, encircled by a groove. Tentacular arms very long and slender, with a large club; tip often with a spoon-shaped organ, opening backward; peduncle with sessile connective suckers; club with rows of singular small suckers, having a swollen bulb on the long pedicel. Pen with a long, narrow shaft, posterior portion involute, tubular.

It is somewhat doubtful whether *Calliteuthis* belongs to this family, its tentacular arms being unknown.

Chiroteuthis D'Orb. (See p. 299).

Chiroteuthis is the only genus in this family that has been hitherto recognized.

8. Chiroteuthis lacertosa Verrill. (pp. 299, 408).

Brachioteuthis Verrill. (See p. 405).

9. Brachioteuthis Beanii Verrill. (p. 406).

Calliteuthis Verrill. (p. 295).

10. Calliteuthis reversa Verrill. (p. 295).

Calliteuthis ocellata (Owen) Verrill. (p. 402).

Family HISTIOTEUTHIDÆ, nov.

Loligopsidæ (*pars*) D'Orbig., Céphal. Acétab., p. 320, 1835–48.
Chiroteuthidæ (*pars*) Gray, Catal. Brit. Mus., Moll., vol. i, p. 42, 1849.

Body small, short, with small caudal fins. Mantle united to the neck by three movable cartilages. Siphon with neither dorsal bridle nor internal valve (?).* Head large. Olfactory crests absent. Eyes large, not prominent; lids free and simple; no sinus. Buccal membrane with six smooth lobes; buccal aquiferous openings four. Nine brachial openings at the bases of the tentacular arms. Six upper arms usually united by a very broad web; sucker-rings convex, with small, oblique apertures. Tentacular arms moderate, with a well-developed club, bearing large, normal, central suckers, and small marginal ones; proximal part of the club with connective suckers and tubercles. Pen broad, short, lanceolate, much like that of *Loligo*.

Histioteuthis D'Orbigny. (See p. 233).

11. Histioteuthis Collinsii Verrill. (pp. 234, 300, 404).

TAONIDEA Verrill.

Eyes large, stalked or prominent, having free lids, but no sinus. Mantle united to base of siphon and back of neck by three muscular commissures. Siphon large, without a true subterminal valve, but usually with special elevated processes, or flaps, in the basal portion. Stomach small, far back; intestine very long, covered with lateral

* According to D'Orbigny there is no valve in this genus, nor in *Chiroteuthis*, but in the latter there is certainly a valve, and it may have been overlooked by him, also, in the former. My specimens lack the siphon.

follicular glands; liver small, far forward; ink-sac small. Pen slender anteriorly, as long as the mantle. Hectocotylized arm not observed. All the arms bear suckers.

Family DESMOTEUTHIDÆ Verrill. (See p. 300).

Body much elongated, mantle united to the neck by three muscular commissures. Siphon without a true valve, but with three peculiar, special thickenings, or raised processes* in its basal portion. Eyes prominent. Intestine very long; ink-sac small.

Desmoteuthis Verrill. (See p. 300).

12. Desmoteuthis hyperboreus (Steenst.) Verrill. (p. 302).

13. Desmoteuthis tenera Verrill. (p. 412).

Taonius Steenstrup, restricted. (See p. 306).

14. Taonius pavo (Les.) Steenstrup. (See p. 306).

MYOPSIDÆ D'Orbigny.

Eyes usually without regular lids; the integument of the head sometimes becomes transparent and extends continuously over the eye; in some genera (*Rossia*, &c.) there is a fold of skin below the eye, constituting a free lower eyelid, while the upper lid is adherent to the eye-ball; but in *Stoloteuthis* the lids are entirely free. The pupil is usually crescent-shaped, or indented on the upper side, but is round in *Stoloteuthis*. Sometimes a small pore in front of the anterior edge of the eye connects with the orbital cavity. Siphon usually with a valve.

This artificial division includes two very diverse groups, which not only differ widely in the condition of the eyes, but also in the nature of the hectocotylization of the arms, and in anatomical characters.

To one of these groups, containing the family *Sepiolidæ*, I propose to apply the name *Sepiolidea*.

The other division, *Sepidea*, includes the families, *Sepidæ*, *Loliginidæ*, *Idiosepidæ*, and perhaps *Spirulidæ;* but the latter might, perhaps, be best placed with fossil forms in a division of which it is the sole surviving genus.

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* Of these organs the median dorsal one is larger and more complicated than the others (see Pl. LV, fig. 2*d*, *m*; and fig. 4*a*). It seems to me probable that this organ is a true homologue of the foot of gastropods.

SEPIDEA Verrill.

The integument extends entirely over the eye and there is a pore in front of it. Pupil crescent-shaped. Body commonly elongated. Pen various, rarely absent, usually large, broad-lanceolate or ovate, either horny or calcareous (spirally coiled, tubular and chambered in *Spirula*, in which it is posteriorly situated.) One of the ventral arms of the male is usually hectocotylized.

Mantle usually with three connective cartilages, rarely with one (dorsal) or three muscular commissures.

Family LOLIGINIDÆ.

Teuthidæ (*pars*) Owen, Proc. Zool. Soc. London, p. 285, 1847.
Loligidæ D'Orbigny, Céph. Acétab., p. 297, 1848.
Loligidæ (*pars*) Gray, Catal. Moll. Brit. Mus., vol. i, p. 66, 1849.
Loliginidæ (*pars*) H. & A. Adams, Genera Moll., vol. i, p. 35.

Body more or less elongated, cylindro-conical. Fins elongated, united and acute posteriorly, sometimes extending the whole length of the body. Pen large, extending the whole length of the mantle, with an acute, short, pen-like anterior shaft, and a broader, thin, lanceolate blade. Connective cartilages of the mantle three, movable. Eyes without a thickened false lid. Siphon provided with an internal valve, and usually with a dorsal bridle. Olfactory crests, about the ears, well-developed. Tentacular club large, with four rows of denticulated suckers on the middle portion. Horny rings of the suckers encircled externally by a raised median ridge.

Loligo Lamarck. (See p. 307).

15. Loligo Pealei Les. (p. 308).

16. Loligo (Lolliguncula) brevis Blainv.* (p. 343).

Sepioteuthis D'Orbig. (See p. 346).

Sepioteuthis sepioidea D'Orb. (p. 345).

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* Professor Steenstrup, in a recent paper (Sepiadarium og Idiosepius.<Vid. Selsk. Skr., 6 R., 1, 3, p. 242, note, 1881), has proposed to make this species the type of a new genus, *Lolliguncula*, because the female receives the spermatophores on the inner surface of the mantle,—a character that seems to be scarcely of generic value, unless it be reinforced by anatomical differences now unknown. Such characters may possibly exist in the unknown males.

SEPIOLIDEA Verrill.

In this group the eye-lids are either entirely free all around, or the upper one may be attached to the eye-ball. Pupil either round or crescent-shaped. Body short, obtuse. Fins lateral, separated. Pen small or rudimentary, sometimes absent. Sucker-rings smooth. Dorsal arms of the male are usually hectocotylized, one or both.

Family SEPIOLIDÆ. (See pp. 347, 416).

Stoloteuthis Verrill. (See pp. 347, 417).

17. Stoloteuthis leucoptera Verrill. (pp. 347, 418).

Inioteuthis Japonica (D'Orb., sp. ?) Verrill. (p. 417).

Inioteuthis Morsei Verrill, sp. nov. (p. 417).

Rossia Owen. (See p. 349).

18. Rossia megaptera V. (p. 349).

19. Rossia Hyatti V. (p. 351).

20. Rossia sublevis V. (pp. 354, 419).

Heteroteuthis Gray. (See p. 357).

21. Heteroteuthis tenera V. (pp. 357, 419).

OCTOPODA Leach. (See p. 360).

Family PHILONEXIDÆ D'Orb. (See p. 361).

Parasira Steenst. (See p. 361).

Vidensk. meddel. naturh. Forening, Kjöbenhavn, 1860, p. 333.

22. Parasira catenulata Steenst. (p. 362).

Family ARGONAUTIDÆ Cantr. (See p. 364).

Argonauta Linné.

23. Argonauta argo Linné. (pp. 364, 420).

Family ALLOPOSIDÆ Verrill. (See p. 365).

Alloposus Verrill. (See p. 365).

24. Alloposus mollis Verrill. (pp. 366, 420).

Family OCTOPODIDÆ D'Orb. (See p. 367).

Octopus Lam. (See p. 367).

25. Octopus Bairdii Verrill. (pp. 368, 421).
26. Octopus lentus Verrill. (p. 375).
27. Octopus piscatorum Verrill. (p. 377).
28. Octopus obesus Verrill. (p. 379.)

Octopus rugosus Bosc. (p. 368).

Octopus vulgaris. (p. 252).

Octopus punctatus Gabb. (p. 252).

Eledone Leach. (p. 380).

29. Eledone verrucosa Verrill. (p. 380).

Family CIRRHOTEUTHIDÆ Keff. (See p. 382).

Stauroteuthis Verrill. (p. 382).

30. Stauroteuthis syrtensis Verrill. (p. 382).

EXPLANATION OF THE PLATES.

All the figures were drawn from nature by Mr. J. H. Emerton, except when otherwise stated.*

PLATE XXVI.

Figure 1.—*Architeuthis Harveyi* V. (No. 24). Young. Pharynx and beak, with odontophore; *o*, œsophagus, natural size.

Figure 2.—The same. Distal part of tentacular arm, with club, natural size.

Figure 3.—The same. Segment from distal portion of left arm of the third pair of sessile arms, front view; 3*a*, the same, side view, natural size.

Figure 4.—The same. Basal portion of right arm, of second pair. Front view, natural size.

Figure 5.—*Architeuthis Harveyi* V. (No. 2). One of the marginal suckers of the club, side view; 5*a*, the same, front view, enlarged 2 diameters.

PLATE XXVII.

Figure 1.—*Desmoteuthis hyperborea* V. Ventral view of a female, ½ natural size.

Figure 2.—The same specimen. Dorsal view of head and arms. Part of the arms are imperfect.

Figure 3.—*Histioteuthis Collinsii* V. Original type. One of the tentacular arms. Front view, ½ natural size.

Figure 4.—Beak of the same specimen; *a*, upper, *b*, lower mandible, natural size.

Figure 5.—Suckers of the same specimen: *a*, side, and *a'*, front view of one of the larger suckers of lateral arm; *b*, side, and *b'* front view of a distal sucker, enlarged 2¼ diameters.

Figure 6.—*Sthenoteuthis megaptera* V. Side view of jaws and odontophore, natural size.

Figure 7 and 7*a*.—*Sthenoteuthis pteropus* V. Upper and lower mandibles, natural size.

Figure 8.—*Rossia Hyatti* V. Side view of young male, natural size.

Figure 9.—The same. Egg containing an embryo; enlarged 6 diameters. The shaded portion represents the yolk still remaining unabsorbed.

Figure 10.—*Onychoteuthis Banksii*. One of the large hooks from the middle of the club; *a*, side view; *a'*, front view; enlarged 4 diameters.

Figure 11.—The same. Corresponding views of one of the smaller hooks of the club.

Figure 12.—The same. Horny ring from one of the small suckers on the proximal cluster of connective suckers and tubercles of the club; *a*, side view; *a'*, front view, enlarged 4 diameters.

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* Most of these figures were drawn in India ink, by Mr. Emerton, for the U. S. Fish Commission, to be engraved in relief, to illustrate a report on the Cephalopods by the writer, which has been printing nearly simultaneously with this article in one of the volumes of the report of Professor S. F. Baird, the Commissioner. To Professor Baird I am greatly indebted for the privilege of first using a large part of the drawings here, which has enabled me to illustrate this article more fully than would, otherwise, have been possible.

PLATE XXVIII.

Figure 1.—*Ommastrephes illecebrosus* V. Young male from Provincetown, Mass. General figure of ventral side. $\frac{6}{7}$ natural size; 1*a*, club of the right tentacular arm, front view, enlarged $1\frac{5}{7}$.

Figure 2.—The same. Club and part of tentacular arm, of a larger ♀ specimen, enlarged $1\frac{5}{7}$ diameters.

Figure 3, 3*a*.—The same. Hectocotylized right ventral arm of a large male specimen, from Eastport, Me., showing the sexual modification of the suckers and their peduncles toward the end of the arm; 3*a* transverse section of the modified portion of the same.

Figure 4.—The same. Pen of a young specimen; $\frac{6}{7}$ natural size.

Figures 5 and 5*a*.—The same. Side and front views of a large sucker of the lateral arms, enlarged $3\frac{3}{4}$ diameters.

Figure 6 and 6*a*.—Side and front views of a smaller, distal sucker of the lateral arms.

Figure 7.—The same. ♀ Side view of the horny ring of one of the largest suckers of the club, enlarged $3\frac{3}{4}$ diameters.

PLATE XXIX.

Figure 1.—*Loligo Pealei* Lesueur. Female from Vineyard Sound. Ventral view, $\frac{2}{3}$ natural size; 1, dorsal arms; 2, 3, 2d and 3d, lateral arms; 4, ventral arms; *t*, tentacular arms; *a*, nuchal olfactory crests, about the ear; *e*, eye; *p*, aquiferous pore; *s*, siphon.

Figure 2.—The same. Tentacular arm of a large male, enlarged $1\frac{1}{2}$ diameters.

Figure 3, 3*a*.—Front and side views of the hectocotylized left ventral arm of a male, showing the sexual modifications of the suckers and their peduncles, toward the tip, enlarged $1\frac{1}{2}$ diameters.

Figure 4.—The same. Female. Front view of the beak and buccal membranes, natural size; *m*, mandibles; *f*, inner fold; *f*, second fold of the buccal membrane; *a*, dorsal; *b*, *c*, lateral; *d*, ventral angles of the outer buccal membrane, with their small suckers; *s*, peculiar horse-shoe shaped tubercle, or sucker, for the attachment of the spermatophores, during copulation.

Figure 5.—*Ommastrephes illecebrosus.* Side view of the head and siphon, after removal of part of the mantle. $\frac{2}{3}$ natural size; 1, 2, 3, 4, bases of 1st to 4th pairs of sessile arms; *t a*, base of tentacular arm; *m*, mantle; *b*, *b'*, olfactory crests around the ear; *d*, siphon; *f*, *f'*, the connective cartilages for attaching it to the mantle.

Figure 5*a*.—The same. Lateral connective cartilage, or 'button' on the inside of the mantle, which fits closely into the cartilage pit (*f*) on the base of the siphon.

PLATE XXX.

Figure 1.—*Rossia Hyatti* Verrill. Female. Ventral view of the head and arms, enlarged 3 diameters.

Figure 2.—*Rossia sublevis* Verrill. Female. Ventral view of the head and arms, enlarged 3 diameters.

PLATE XXXI.

Figure 1.—*Rossia Hyatti.* Dorsal view, enlarged $1\frac{1}{2}$ diameters.

Figure 2.—The same. A young specimen, enlarged $1\frac{1}{2}$ diameters.

Figure 3.—*Rossia sublevis.* Ventral view, enlarged 1½ diameters.

Figure 4.—*Stoloteuthis leucoptera* Verrill. Female. Young, ventral view, enlarged 3 diameters.

Figure 5.—The same. Male. A larger specimen, taken in 1879, enlarged 1½ diameters.

Plate XXXII.

Figure 1.—*Stauroteuthis syrtensis* V. Dorsal view, $\frac{3}{10}$ natural size.

Figure 2.—The same. Lower side of head; *s*, siphon; *e*, eye; *a*, the auditory pore.

Figure 3.—The same. The siphon, turned back.

Figures 4 and 5.—The same. Superior and inferior mandibles, enlarged 2⅔ diameters.

This plate was drawn by the author, from the alcoholic specimen, except figs. 4 and 5, which are by J. H. Emerton.

Plate XXXIII.

Figure 1.—*Octopus Bairdii* Verrill. Male. Ventral view, natural size; *h*, terminal organ of the hectocotylized arm; *i*, the groove along the lower side of the arm.

Figure 1*a*.—The same specimen. Hectocotylized arm, enlarged two diameters.

Figure 2.—*Parasira catenulata* Steenst. Female. Front view, ½ natural size.

Figure 2*a*.—The same specimen. Side view, ½ natural size.

Plate XXXIV.

Figure 1.—*Loligo Pealei*, var. *pallida* V. Male. Dorsal view, about ¼ natural size.

Figure 2.—The same. Pen, about ½ natural size.

Figure 3.—The same. Portion of radula, much enlarged.

Figure 4.—The same. Upper mandible: *a*, rostrum or tip of the beak; *b*, the notch; *c*, the inner end of ala; *d*, the frontal lamina; *e*, the palatine lamina: *ab*, the cutting edge of beak; *bc*, anterior or cutting edge of ala.

Figure 4*a*.—Lower mandible: *a*, rostrum; *ab*, cutting edge; *bc*, anterior edge of ala; *d*, mentum or chin; *e*, gular lamina.

Figure 5.—*Octopus Bairdii* V. Young male. Side-view from a living specimen, nearly natural size.

Figure 6.—The same. Dorsal view, from life, nearly natural size.

Figs. 3, 4, 4*a*, were drawn by the author; the others by J. H. Emerton.

Plate XXXV.

Figure 1.—*Octopus leutus* V. Female. Original specimen. Ventral view, ⅔ natural size.

Figure 2.—The same specimen. Dorsal view, ⅔ natural size.

Plate XXXVI.

Figure 1.—*Octopus piscatorum* V. Female. Original type. Ventral view, ⅔ natural size.

Figure 2.—The same specimen. Dorsal view.

Figure 3.—*Octopus obesus* V. Male. Original type. Basal portion of one of the lateral arms, to show the arrangement of suckers, natural size.

Figure 4.—The same specimen. Terminal portion of the hectocotylized arm, enlarged 1¼ diameters.

Figure 5.—*Sthenoteuthis pteropus* V., from Bermuda. Female. Anterior end of pen, natural size.

Figure 5*a*.—Posterior end of the same pen.

Figure 6.—The same specimen. Connective cartilage from base of the siphon, natural size.

Figure 7.—The same specimen. Transverse sections of arms; *a*, of dorsal; *b*, of 2d pair; *c*, of third pair, natural size. The suckers are omitted.

Figure 8.—The same specimen. Rims of suckers of sessile arms, enlarged 1½ diameter; *a*, *a'*, side and front views of the 15th and 13th sucker of a ventral arm; *b*, *b'*, side and front view of one of the largest suckers of a lateral arm; *c*, *c'*, a dorsal sucker of a dorsal arm.

Figure 9.—Part of border of one of the larger suckers (12th) of the second pair of arms, more enlarged, showing part of the dentate edge of the horny rim, with a portion of the circle of small plates, attached to the membranous border.

Figure 10.—*Octopus Bairdii* V. Spermatophores. A, one with the inner sac (*S*) partly extruded; *i*, the point from which the extension commences, natural size; B, another spermatophore in its original condition; *a*, filament at large end; *b*, filament at small end.

Plate XXXVII.

Figure 1.—*Loligo Pealei* Les. Female specimen from Vineyard Sound. Pen, natural size and represented as flattened to show the full width of the thin portion.

Figure 2.—*Loligo Pealei*, var. *borealis*. Female specimen, from Annisquam, Mass. Pen, natural size, represented in the same manner.

Figure 3.—*Loligo Pealei*. Pen of a young specimen from Vineyard Sound, natural size. Represented in the same way.

Figure 5.—*Histioteuthis Collinsii* V. Teeth of the odontophore, isolated and enlarged 25 diameters; *a*, median; *b* inner lateral; *c*, and *d*, outer laterals; *e*, marginal plate; *h*, *g*, and *f*, other views of the lateral teeth. The teeth are not drawn in their natural positions.

Figure 6.—*Loligo pallida* V. Part of teeth of the odontophore, enlarged 50 diameters; *a*, median tooth, front view; *c*, next to outer lateral teeth; *d*, outer lateral teeth; *e*, marginal plates; all are in their natural positions, except *a*.

Figure 7.—*Sthenoteuthis pteropus* V., from Bermuda. Isolated teeth from odontophore, enlarged 25 diameters; *a*, median teeth, front view; *b*, inner lateral; *c*, middle lateral; *d*, outer lateral tooth.

Figure 8.—*Ommastrephes illecebrosus* Les., from Eastport, Me., part of the teeth of the odontophore in their natural positions, enlarged 25 diameters; *a*, median teeth; *b* and *b'*, inner lateral teeth; *c*, middle lateral teeth; *d*, outer lateral teeth.

Figure 9.—*Loligo Pealei*, var. *pallida* V. Female, from Ansonia, N. Y. Tenth sucker of the third pair of arms; *a*, lateral, and *b*, front view, enlarged 2 diameters.

Figure 10.—The same. Male, from Ansonia. Suckers enlarged 2 diameters; *a*, front view of tenth, from third arm; *b*, side view of same; *c*, side view of horny rim of fifth large sucker of tentacular club; *d*, front view of the same.

Figure 11.—*Loligo Pealei*, var. *pallida*. Female. (Same specimen as figure 9.) Fifth large sucker of tentacular arm; *e*, side, and *f*, front view. Enlarged 2 diameters.

Figures 5–8 are from camera-lucida drawings by the author; the others are by J. H. Emerton.

Plate XXXVIII.

Figure 1.—*Rossia megaptera* V., sp. nov. Dorsal view, natural size.

Figure 2.—*Ommastrephes illecebrosus*. Male, $\frac{1}{3}$ natural size. Opened on the ventral side. The peritoneal membrane, most of the renal organs on the right side, and the reproductive organs, except the testicle (*t*), have been removed. M, mantle cut open; F, caudal fin; P, posterior part of pen; S, stomach; S′, cœcal lobe; H, systemic heart; *e*, the eye; *b*, olfactory or nuchal crests; *d*, siphon; *f*, *f*, connective cartilages on the base of the siphon; *f′*, *f′*, connective cartilages of the mantle, which fit into *f*, *f*; *m′*, lateral muscles of neck; *g*, *g*, gills; *l*, liver; *i*, ink-sac; *h*, intestine or rectum; *a o*, anterior aorta, going to head; *b o*, efferent branchial vessel; *o*, median ventral artery of mantle; *o′*, *o′*, lateral arteries going to mantle and fins; *a u*, branchial auricles; *v c*, anterior vena-cava; *v c″*, posterior vena-cava of left side (the right one has been removed); *r*, *r*, saccular ventral renal organs; *r′*, more compact glandular (renal) organ, connected with the posterior venæ-cavæ; *t*, testicle or spermary; *p″*, hooded posterior tip of pen, enclosing the end of the spermary. From an alcoholic specimen.

Figure 3.—*Architeuthis Harveyi* V. (No. 24). Sucker (50th) of lateral arm, second pair, showing the scales around the aperture, front view, enlarged about 4 diameters.

Figure 4.—The same specimen. Otolith; *a*, side-view; *b*, front-view.

Figure 5.—The same specimen. Portion of radula, showing most of three transverse rows of teeth; *a*, median teeth; *b*, *b′*, inner-lateral teeth; *c*, *c′*, and *d*, two outer-lateral rows of teeth, much enlarged.

Figure 6.—The same, more enlarged, lettered as in fig. 5.

Figure 7*c′*.—The same. One of the teeth from the outer-lateral row.

Figure 8.—*Octopus Bairdii* V. Male. Figured in the act of swimming, dorsal view; *a*, terminal spoon of hectocotylized arm. From a living specimen, nearly natural size.

Plate XXXIX.

Figure 1.—*Desmoteuthis hyperborea* V. Female. Specimen opened on the ventral side. M, mantle; F, caudal fin; P, P′, posterior part of pen; *e*, *e*, eyes; *d*, siphon; *d o*, aperture of same; *d″*, base and posterior entrance of same; *f′*, commissure attaching the siphon to the mantle laterally; *g*, *g*, gills; *h*, rectum; S, S, S, divisions of stomach and cœcal lobe; *l*, *l*, long tubular intestine, plicated within, and with rows of follicular glands along each side; *i*, liver and ink-sac; H, systemic heart or ventricle; *b o*, branchial efferent vessels; *a u*, branchial auricles; *v c″*, posterior vena-cava; *r′*, renal organs; *o v*, ovary; *o v′*, some ovules larger than the rest; *o p*, *o p*, right and left oviducts; *x′*, nidamental glands of the oviducts; *x x*, *x x′*, accessory nidamental glands. From a mutilated specimen.

Figure 2.—*Ommastrephes illecebrosus*. Female, less than natural size. Lettering as in Plate 38, fig. 2, with the following additional letters: *b″*, lower nuchal facet, with the auditory pore; *u*, urethreal openings in the peritoneal membrane, communicating between the gill-cavity and the visceral cavity, containing the renal organs, *r*, *r*; *v c′*, lateral pallial veins, or venæ-cavæ; *o v*, ovary; *o d*, *o d′*, right and left oviducts; *o p*, the anterior opening; *o x*, *o x*, nidamental glands.

Figure 3.—*Ommastrephes illecebrosus*. Jaws enlarged 1½ diameters: *a*, superior; *b*, inferior mandible.

Figure 4.—*Loligo Pealei*. Portion of the radula, much enlarged.

PLATE XL.

Figure 1.—*Loligo Pealei*, var. *pallida*. Male. Ventral view, about $\frac{2}{3}$ natural size. The mantle has been cut open, a little to one side of the median line; most of the peritoneal membrane has been removed. C, lower side of head; M, mantle; F, caudal fin; *a*, lachrymal pore; *b*, olfactory crests; *c*, eye; *d*, siphon, cut open; *d''*, cavity of siphon; *e*, valve of siphon; *f*, one of the connective cartilages of the siphon; *f'*, one of the connective cartilages of the mantle, in the form of a ridge, fitting into the siphonal cartilage; *g*, gill; *h*, termination of the intestine, or rectum; *i*, ink-sac; *i'*, duct of ink-sac; *l*, portion of liver, in position; *m'*, *m'*, muscular columns connecting the head and siphon with dorsal portion of the body; H, systemic heart, or ventricle, crossed by the artery of the ink-sac; *a o*, bulbous base of anterior aorta; *o*, ventral pallial artery, or median branch of the posterior aorta, supplying the ventral parts of the mantle; *o'*, one of the caudal arteries or lateral branches of the posterior aorta going to the caudal fin and posterior parts of the mantle; *a u*, *a u*, branchial auricles; *b v*, afferent vessel going to the gills; *b o*, efferent branchial vessels, returning the blood to the ventricle, their swollen basal portions acting as auricles; *v c*, anterior vena-cava; *r*, *r*, ventral renal organs, two ventral sacculated branches of the vena-cava (on the left side, the vein from the ink-sac and rectum is shown); *r'*, *r'*, two pyriform renal organs, or sacculated and glandular portions of the posterior venæ-cavæ, directly connected with *r*, *r*; *v*, *v c'*, lateral pallial veins, going to the dorsal sacculated divisions of the venæ-cavæ; *v c''*, *v c''* two posterior venæ-cavæ, returning from the caudal fin and mantle; S, first stomach, or gizzard; S', large, saccular cœcal appendage of the stomach; *k*, glandular, plicated division of the stomach; *t*, spermary or testicle; *p r*, prostate gland, with the vesiculæ-seminales and spermatophore-sac; *p*, efferent sperm-duct or 'penis'; P, posterior portion of the pen.

Figure 2.—The same. Dorsal view of the reproductive organs, part of the renal organs, heart, etc., dissected out. The lettering is as in figure 1, with the following additions: *v d*, vas-deferens, closely folded upon itself; *s s*, spermatophore-sac; *p o*, genital artery; *g o*, spermatic artery and vein; S'', commencement of intestine: *p t*, part of peritoneal membrane.

Figure 3.—*Loligo Pealei*. Female in the breeding season. Oviduct, filled with ova, dissected out. Ventral view, about $\frac{1}{2}$ natural size; *v o*, commencement of convoluted, thin membranous portion of oviduct; *o d*, entrance to glandular portion; *o d'*, glandular portion of oviduct, surrounded by the large, laminated gland, *x'*, the arterial vessels of which have been injected; *o p*, orifice of the oviduct.

Figure 3*a*.—The same specimen, seen from the dorsal side.

Figures 4*a*, 4*b*.—*Loligo Pealei*. Male. Side and front views of horny rim of one of the marginal suckers of the tentacular club, enlarged 10 diameters.

Figure 5.—The same. Portion of the rim and marginal denticles of one of the large median suckers of the tentacular club, much enlarged.

Figures 3, 3*a* are by the author; the others by J. H. Emerton, from alcoholic specimens.

PLATE XLI.

Figure 1.—*Loligo Pealei*, var. *borealis*. Female, in the breeding season. Ventral view, about $\frac{1}{2}$ natural size. The mantle has been cut open nearly in the median line and the peritoneal membrane partly removed. The lettering is the same as

in fig. 1 of Pl. XL, with the following additions: 1, 2, 3, 4, first, second, third and fourth pairs of sessile arms; *t a*, tentacular arms; *d'*, external orifice of siphon; *o v*, *o v'*, ovary, mostly concealed by the oviduct; *v o*, commencement of glandular portion of oviduct; *x'*, large gland surrounding the oviduct; *o d'*, anterior portion of oviduct; *o p*, orifice of oviduct; *x x*, pair of large, ventral, laminated, nidamental glands; *x*, pair of follieulated and mottled accessory nidamental glands; *u*, one of the urethral openings of the peritoneal membrane.

Figure 2.—*Loligo Pealei.* Embryo taken from the egg, ventral view, much enlarged; *a*, *a*, *a*, ventral arms, tentacular arms, and third pairs of sessile arms; *c*, *c*, eyes on stout peduncles or lobes from the sides of the head; *m*, mantle-edge; *h*, branchial auricles; *y*, unabsorbed yolk-mass.

Figure 3.—The same. An embryo, within the egg, somewhat more advanced than fig. 2, side view, less enlarged. The lettering is as in fig. 2, with the following additions: *a'*, second pair of arms; *a''*, third pair; *a'''*, tentacular arms; *a''''*, ventral arms; *s*, orifice of siphon; *o*, otolith; *f*, rudimentary caudal fins. Chromatophores are developed on the mantle.

Figure 4.—The same. An embryo at the period of hatching. Ventral view, enlarged about 25 diameters. The yolk-sac is nearly absorbed.

Figure 5.—The same. A somewhat older larva, taken swimming at the surface. Dorsal view, enlarged about 7 diameters. The dorsal arms are still very small; the tentacular arms are the largest; the chromatophores are large and symmetrically arranged, but only part of them are figured; the caudal fins do not reach the posterior end.

Figures 2 and 3 are from camera-lucida drawings of living specimens by the author; 4 is by J. H. Blake from life; 1 and 5 are by J. H. Emerton, from alcoholic specimens.

PLATES XLII, XLIII, AND XLIV.

These relate to the next article, which see.

PLATE XLV.

Figure 1.—*Lestoteuthis Fabricii* Verrill. Young. Pen, enlarged two diameters. Copied from G. O. Sars.

Figure 1*a*.—The same. Part of odontophore. Copied from G. O. Sars.

Figure 1*b*.—The same. Portion of tentacular club, front view, enlarged. Copied from G. O. Sars.

Figure 2.—The same. Young. General figure, dorsal view, enlarged two diameters. From an American example.

Figures 2*a*, 2*b*.—The same. Front and side views of one of the suckers from the outer rows of a lateral arm of the same specimen.

Figures 2*c*, 2*d*.—The same. Front and side views of a hook-sucker from the median rows of the same arm.

Figure 3.—*Loligo Pealei.* Young female. Dorsal view of a specimen taken at Newport, R. I., in August. Enlarged two diameters. From a fresh specimen.

Figure 4.—The same. Young, just hatched. Ventral view, seen as a transparent object from a specimen raised from the eggs, at Newport, R. I., August 5th. Much enlarged; *a''*, *a'''*, *a''''*, three of the pairs of arms, showing the suckers on *a'''*, the tentacular arms; *d*, the beak; *l*, odontophore; *e*, the eye; *f*, caudal fin; *g*, gill; *h*, ventricle of the heart; *h'*, *h''*, branchial auricles; *i*, ink-bag; *m*, mantle; *o*, otoliths; *s*, siphon; *s'*, base of siphon; *t*, end of intestine; *u*, stomach; *y*, portion of yolk-sac, not yet absorbed.

Figure 5.—*Sthenoteuthis megaptera* V. Beak and inner buccal membrane, front view, natural size.

Figure 5*a*.—The same. Large sucker from the tentacular arm of the same specimen, front view, enlarged two diameters.

PLATE XLVI.

Figure 1.—*Calliteuthis reversa* Verrill. Female. Ventral view, natural size.

Figure 1*a*.—The same. Beak, buccal membranes and base of arms, front view, natural size.

Figure 1*b*.—The same. One of the larger suckers from a lateral arm, enlarged.

Figure 2.—*Heteroteuthis tenera* Verrill. Dorsal view of female, enlarged two diameters.

Figure 2*a*.—The same. Tentacular club, enlarged four diameters.

Figure 2*b*.—The same. Pen, enlarged four diameters.

Figure 2*c*.—The same. Jaws, side view, enlarged four diameters; *a*, superior; *b*, inferior mandible.

Figure 2*d*.—The same. Part of the odontophore, much enlarged.

Figure 3.—The same. Front view of male, enlarged two diameters.

Figures 3*a*, 3*b*.—The same. Front and side-views of one of the suckers of the lateral arms of the same specimen.

Figure 4.—*Rossia sublevis* Verrill. Pen from ♀ (see Plate 47, fig. 2), enlarged four diameters.

Figure 5.—*Rossia Hyatti* Verrill. Female. Suckers, enlarged fifteen diameters; *a*, one of the largest from third pair of arms, side-view; *b*, *c*, two forms of suckers from the tentacular club.

Figure 6.—*Rossia megaptera* Verrill. Female. Suckers, enlarged fifteen diameters; *a*, front view of one of the largest from third pair of arms; *b*, *c*, *d*, three suckers from the tentacular club.

Figures 5 and 6 are camera-lucida drawings by the author; the rest are by J. H. Emerton.

PLATE XLVII.

Figure 1.—*Chiroteuthis lacertosa?* Verrill. One of the tentacular arms, outer side, natural size.

Figure 1*a*.—The same. Front view of club, enlarged two diameters.

Figure 1*b*.—The same. One of the suckers, enlarged.

Figure 2.—*Rossia sublevis, var.* Verrill. Female. Dorsal view, natural size.

Figure 2*a*.—The same. One of the suckers of the tentacular club, side-view, much enlarged.

Figure 2*b*.—The same. Marginal scales on the edge of the sucker, more enlarged.

Figure 3.—The same. One of the arms of the third pair, from another female example, enlarged two diameters.

Figure 4.—The same. Corresponding arm of the male.

Figure 5.—*Heteroteuthis tenera* Verrill. Dorsal view of male, enlarged two diameters.

Figure 5*a*.—The same. One of the larger marginal suckers of the tentacular club; front view, much enlarged.

Figure 5*b*.—The same. Portion of the margin of the sucker, more enlarged; to show the scales.

PLATE XLVIII.

Figure 1.—*Mastigoteuthis Agassizii* Verrill. Dorsal view, slightly enlarged.

PLATE XLIX.

Figure 1.—*Lestoteuthis Fabricii* V. (*Cheloteuthis rapax* Verrill.) Club of tentacular arm, front view, enlarged two diameters. The horny hooks are lost from the claws, *a*, *a'*, *a''*; *b*, *c*, small lateral suckers; *d*, *d'*, small suckers of distal portion; *e*. *e'*, connective suckers and tubercles.

Figure 1*a*.—The same. One of the suckers corresponding to *c* of fig. 1, front view, much enlarged.

Figure 1*b*.—The same. A small sucker, corresponding to *a* of fig. 1.

Figure 1*c*, 1*d*.—The same. Front and side-views of one of the claws, with its enclosed horny hook or 'nail,' from the middle of a lateral arm, enlarged eight diameters.

Figure 1*e*.—The same. Connective cartilage from base of siphon, front view, enlarged two diameters.

Figure 1*f*.—The same. Beak and pharynx, side view, enlarged two diameters.

Figure 2.—*Mastigoteuthis Agassizii* Verrill. Front view of the beak, buccal membranes (*b*. *d*), and bases of the arms; enlarged two diameters.

Figure 3*a*.—The same. Side view of head, siphon, and anterior part of mantle, showing the cartilage (*c*), on the inner surface of the mantle, which interlocks with *c'* on the base of the siphon; *e*. olfactory (?) papilla, near the ear; *p*, an aquiferous pore (?); *s*, siphon; *t a*, base of tentacular arms; 1, 2, 3, 4, bases of corresponding pairs of arms.

Figure 3*b*.—The same. Pen, ventral view enlarged two diameters.

Figure 3*c*.—The same pen. Side-view.

Figure 3*d*.—The same. Portion from near the end of one of the tentacular arms, enlarged sixteen diameters.

Figure 3*e*.—The same. Suckers from the tentacular arm, much enlarged: *a*, side-view; *a'* and *a''*, nearly front views.

Figure 3*g*.—The same. One of the suckers from the middle of a lateral arm, front view, much enlarged.

Figure 4.—*Octopus Bairdii* Verrill. Portion of odontophore, much enlarged.

Figure 4*a*.—The same. Jaws: *s*, superior; *i*, inferior mandibles, enlarged two diameters.

PLATE L.

Figure 1.—*Alloposus mollis* V. Young male. Side view, showing the sac containing the hectocotylized arm, cut open, so as to expose the partially developed arm. One-half natural size.

Figure 1*a*.—The same. Hectocotylized arm removed from the sac, enlarged two diameters.

Figure 2.—The same. Young female. Ventral view, one-half natural size.

Figure 2*a*.—The same specimen. Dorsal view, one-half natural size.

PLATE LI.

Figure 1.—*Octopus Bairdii, var.* Verrill. Side view of a young male, enlarged about two diameters.

Figure 1*a*.—The same. Terminal appendage of the hectocotylized arm, enlarged eight diameters.

Figure 2.—*Octopus lentus* Verrill. Side view of a male, enlarged about two diameters.

Figure 3.—*Alloposus mollis* Verrill. Portion of an arm, with suckers, from near the base, natural size.

Figure 4.—*Alloposus mollis* Verrill. Terminal portion of a mature, detached hectocotylized arm, natural size.

PLATE LII.

Figure 1.—*Eledone verrucosa*, Verrill. Side view of the male, natural size.

Figure 1*a*.—The same. Distal portion of the hectocotylized arm, to edge of basal web, showing the terminal appendage and the lateral groove.

PLATE LIII.

Figure 1.—*Eledone verrucosa*, Verrill. Dorsal view of the male, natural size.

PLATE LIV.

Figure 1.—*Architeuthis princeps* V. Side view. Restored mostly from No. 13. One-twenty-fourth natural size.

Figure 2.—*Sthenoteuthis pteropus* V. Side view of the specimen from Bermuda. One-fourth natural size.

Figure 2*a*.—Caudal fin of the same specimen. Dorsal view, one-fourth natural size.

Figure 3.—*Loligo Pealei* Les. Portion from the middle of the tentacular club of a specimen having unusually small tentacular suckers; *a*, *a'*, largest median suckers; *b*, *b'*, lateral suckers, enlarged 4 diameters.

Figure 4.—*Stoloteuthis leucoptera* V. Male. Second lateral arm, showing the greatly enlarged middle suckers, enlarged 4 diameters.

PLATE LV.

Figure 1.—*Lestoteuthis Fabricii* V. One of the tentacular arms; enlarged 2 diameters.

Figure 1*a*.—The same. The larger claw. Side view.

Figure 1*b*.—The same. Lateral arm; enlarged 2 diameters.

Figures 1*b'*, 1*b''*.—The same. One of the hooks; enlarged 8 diameters.

Figure 1*c*.—The same. Portion of ventral arm; enlarged 2 diameters.

Figure 1*d*.—The same. Pen, ventral view; natural size.

Figure 2.—*Desmoteuthis tenera* V. General figure of male, dorsal view; natural size.

Figure 2*a*.—The same. Teeth of odontophore; enlarged 22 diameters.

Figure 2*b*.—The same. One of the larger suckers of the lateral arms, front view; enlarged 8 diameters.

Figure 2*c*.—The same sucker; side view.

Figure 2*d*.—Valve-like apparatus within base of siphon; natural size; *S*, orifice of siphon; *m*, median organ; *i'*, lateral papilla, and *i*, medio-dorsal papilla; *n*, *n'*, lateral cushions.

Figure 3.—*Brachioteuthis Beanii* Verrill. Dorsal view of the male; natural size.

Figure 3*a*.—The same. Pen, ventral view; enlarged slightly.

Figure 3*b*.—The same. Teeth of the radula; enlarged 22 diameters.

Figure 4.—*Desmoteuthis hyperborea*. Side view of one of the large suckers of the 3d pair of arms, side view; enlarged 8 diameters.

Figure 4*a*.—The same. Peculiar organs on the interior of the medio-dorsal side of the base of the siphon; enlarged 2 diameters; *i*, median, *i'*, lateral papillæ.

Figure 5.—*Chiroteuthis lacertosa* V. Young female. One of the suckers of the tentacular arms, front view; enlarged 22 diameters.

Figure 6.—*Histioteuthis Collinsii*. One of the larger suckers of the median rows of the tentacular club, side view; enlarged 2 diameters.

Figure 6*a*.—The same. One of the suckers of the sublateral rows of the tentacular club.

Plate LVI.

Figure 1.—*Chiroteuthis lacertosa* Verrill. Dorsal view of the male; three-quarters natural size; *t a*, stump of one of the tentacular arms, with a few of the sessile suckers remaining.

Figure 1*a*.—The same. Ventral view of the pen; enlarged 3 diameters.

Figure 1*a'*.—The same. Section of the anterior part of the pen; 1*a''*, section of the posterior part of the pen; much enlarged.

Figure 1*b*.—The same. Connective cartilage of siphon; enlarged 3 diameters.

Figure 1*c*.—The same. Lateral connective cartilage of mantle.

Figures 1*d*, 1*e*.—The same. One of the larger suckers of the 3d pair of arms, front and side views; enlarged 6 diameters.

Figure 1*f*.—The same. Papilla from behind and below the eye; enlarged 3 diameters.

Figure 2.—*Brachioteuthis Beanii* V. Connective cartilage of the mantle; enlarged.

Figure 2*a*.—The same. Lateral connective cartilage of the siphon; enlarged.

Figure 3.—*Desmoteuthis tenera* V. Tentacular arm; enlarged 3 diameters.

ERRATA.

Pages 185, 206–208, correct description of pen, as on p. 395.

Page 187, line 11, for M. Gabriel, read E. Gabriel.

Page 190, line 32, for 2·5, read 3·5.

Page 193, line 11, for 1878, read 1879.

Page 213, line 11, for ·22, read 22.

Page 214, line 25, and page 215, line 6 from bottom, for ventral, read lateral.

Page 250, lines 22–25, omit the paragraph relating to *Dosidicus;* line 29, for median hook, read serrated ring; last line, for *A. Kamschatica*, read *L. Kamtschatica.*

Page 251, lines 18, 24, omit *Dosidicus;* lines 22, 25, for solid cartilaginous, read hollow; line 34, for *Kamschatica*, *read Kamtschatica.*

Pages 268, 277, 278, 279, 280, 281. 289, 290, 293, for *illecebrosa*, read *illecebrosus.*

Page 290, line 8 from bottom, for *Gonatus* Gray, read *Gonatus* G. O. Sars, Steenst., *non* Gray; omit quotation from Gray; line 3 from bottom, after sessile arms, insert except the ventral, [see p. 388].

Page 291, line 12, for Verrill, read Steenstrup; lines 17–22, omit references to Möller, Gray, Tryon; line 7 from bottom, after developed, insert (except on those of the ventral).

Page 292, line 26, and p. 293, line 1, for *Chiloteuthis*, read *Cheloteuthis* (=*Lestoteuthis*), [see p. 387].

Page 299, line 1, for *Bonplandi* D'Orb , read *lacertosa?* Verrill. and omit syonymy.

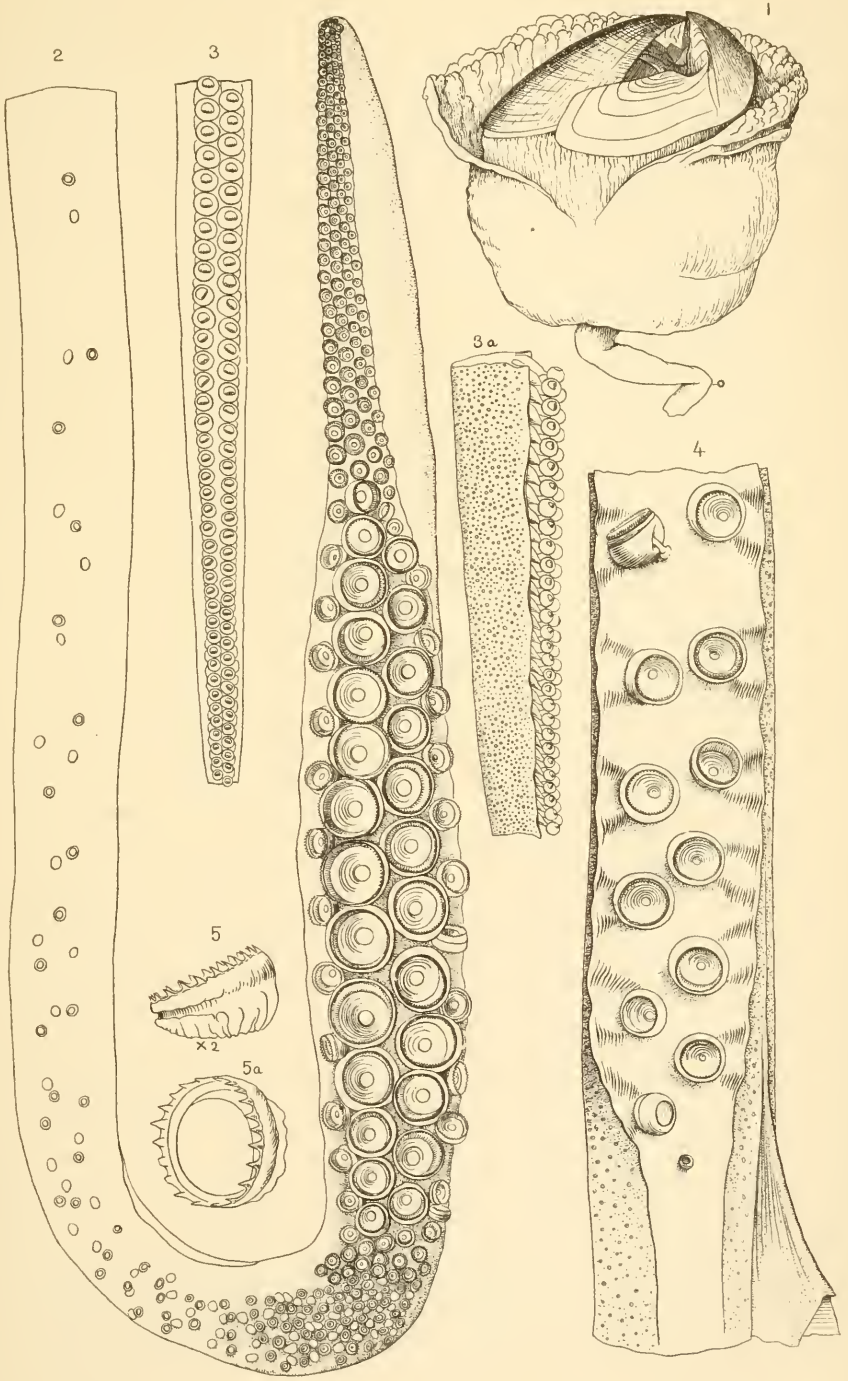
Page 305, line 10 from bottom, for posterior, read terminal.

Page 338, line 26, for anterio-, read antero-.

Page 347, for *Sepiola*, read *Stoloteuthis;* omit references to Leach, Gray, [see p. 417].

Page 379, line 4, for 3*a*, read 4.

Page 385, line 23, for Oversight, read Oversigt.



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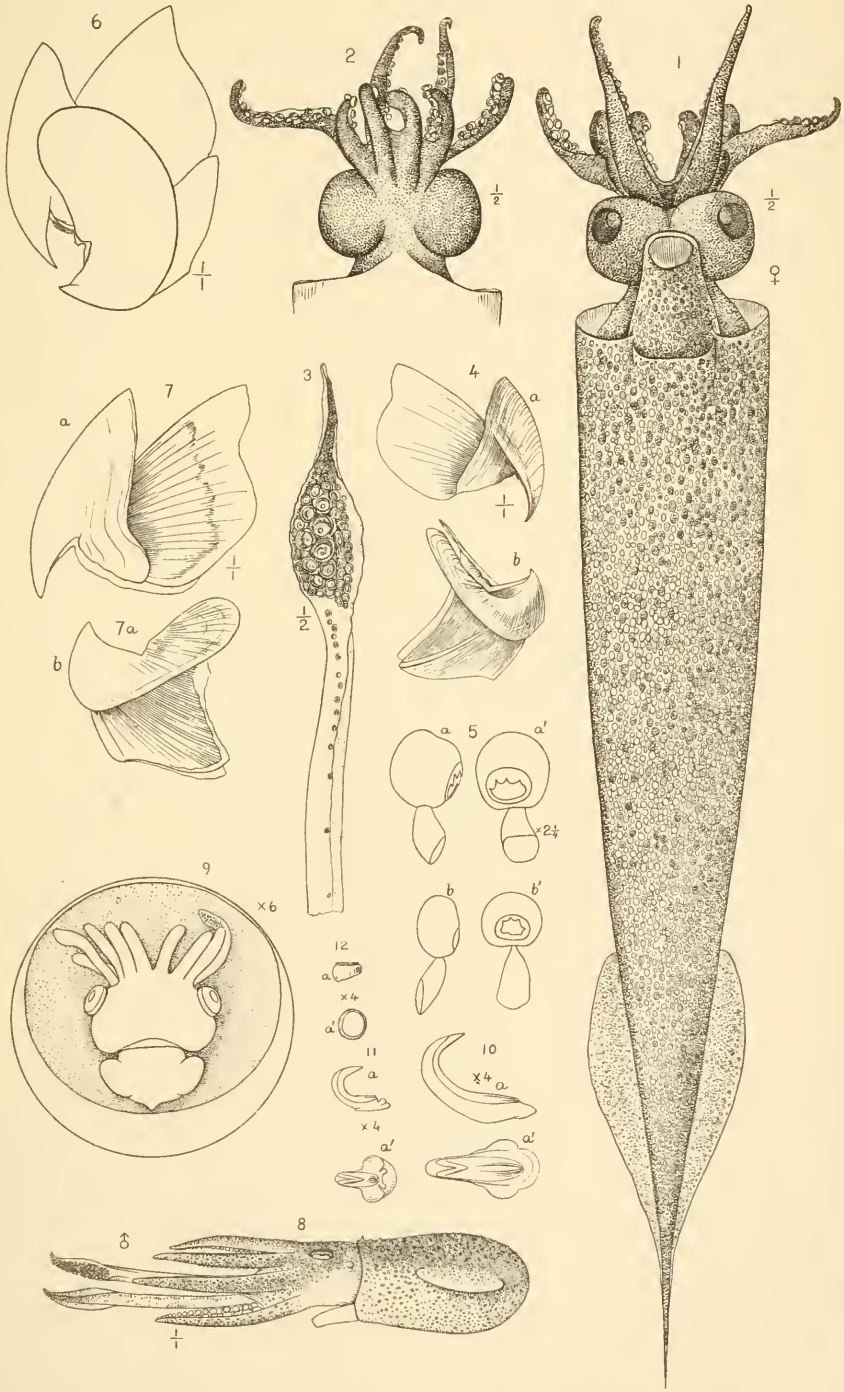
ARCHITEUTHIS HARVEYI VERRILL



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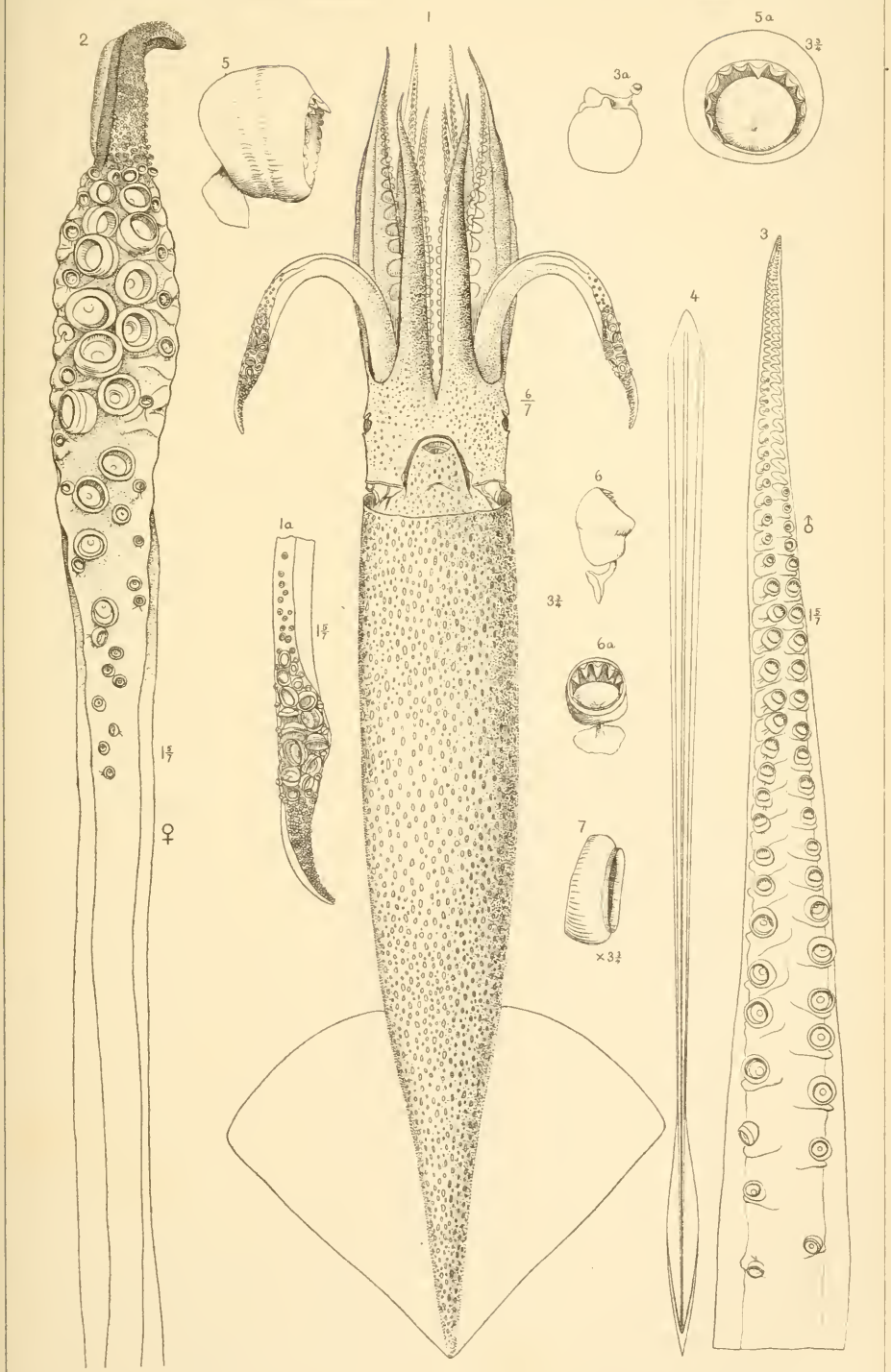
TAONIUS HYPERBOREUS ST., HISTIOTEUTHIS COLLINSII V. etc



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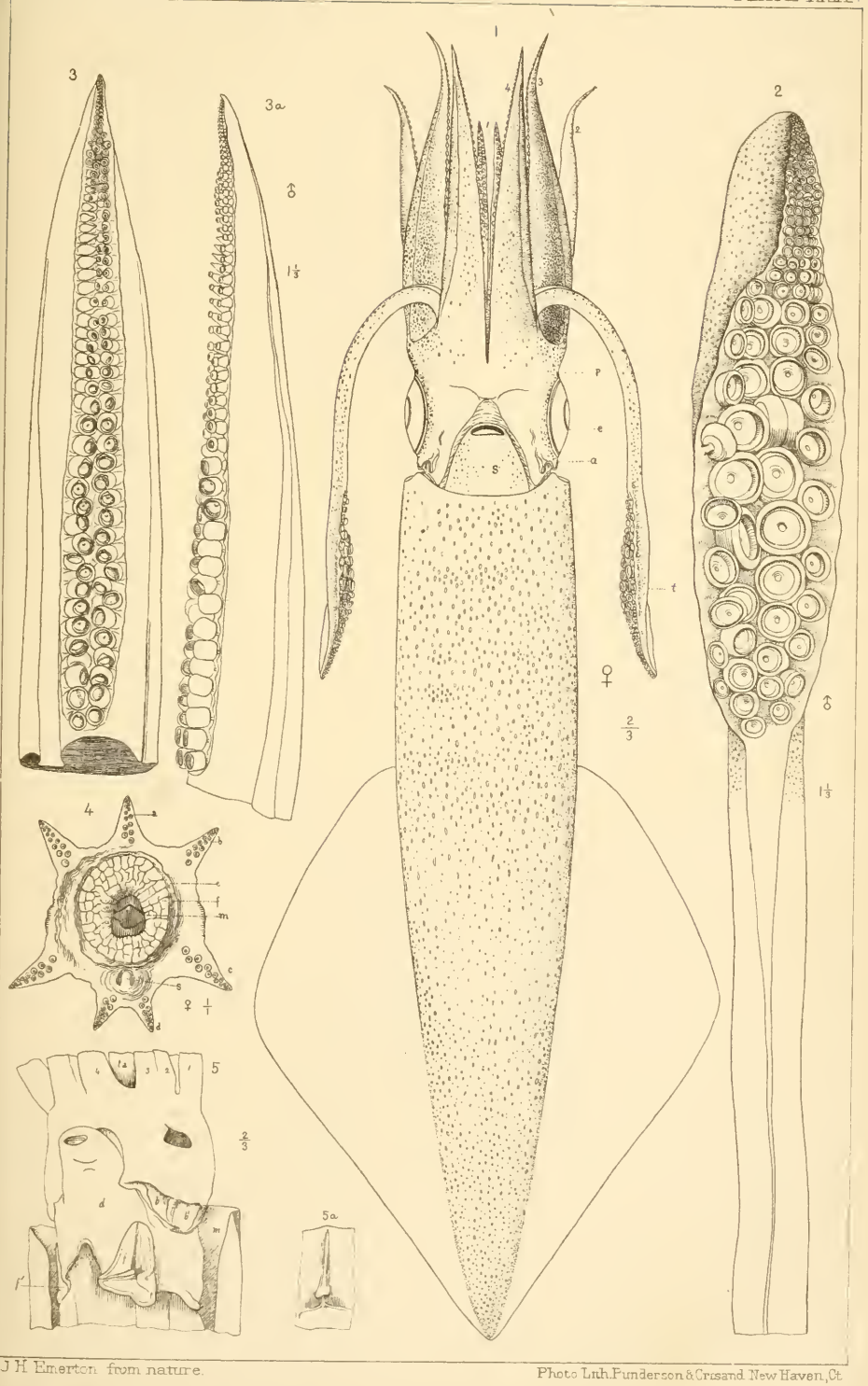
OMMASTREPHES ILLECEBROSA VERRILL



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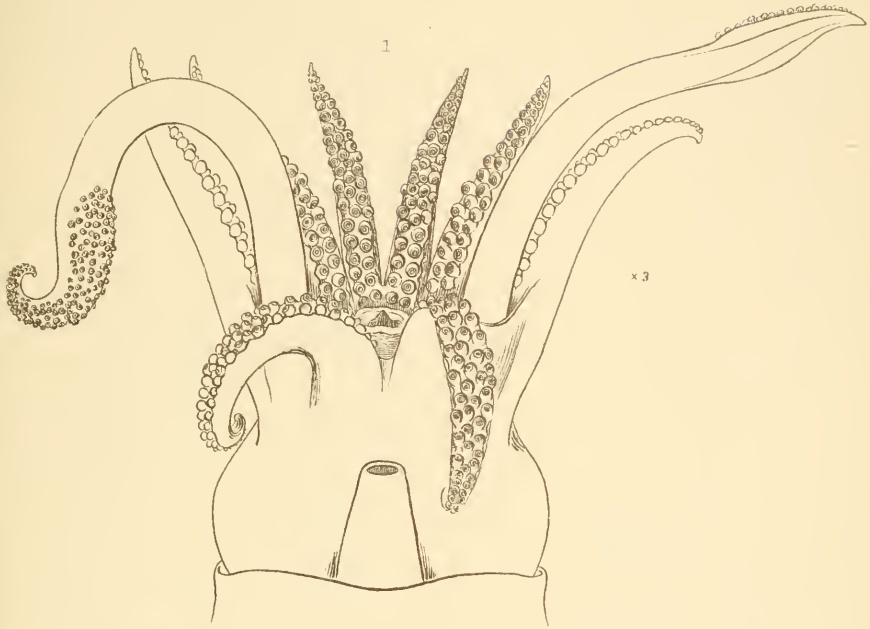
LOLIGO PEALEI LES. AND OMMASTREPHES ILLECEBROSA V.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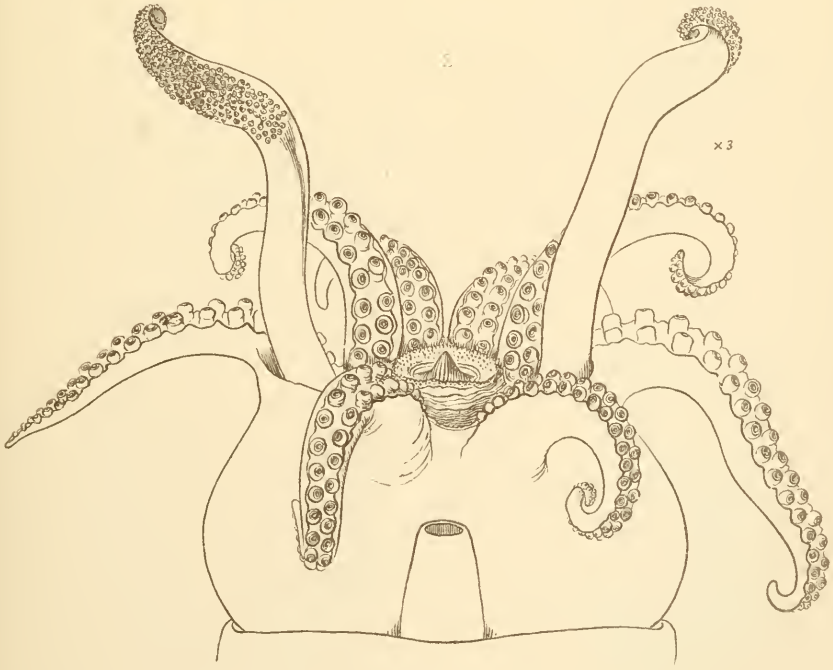
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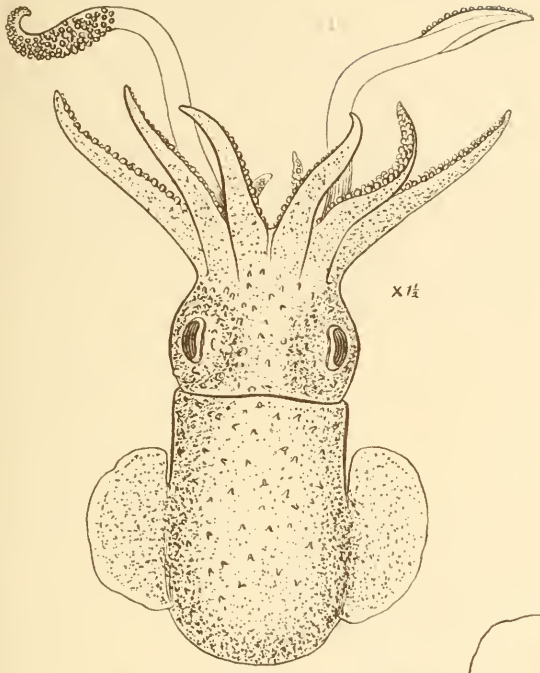
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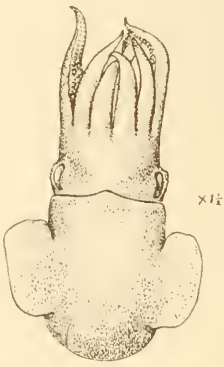
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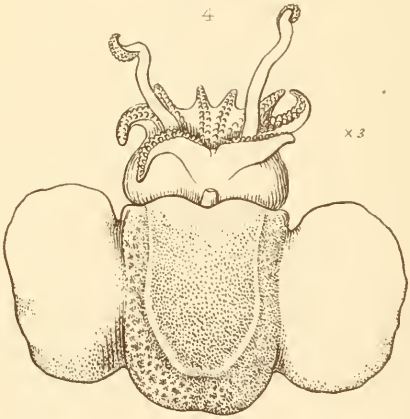
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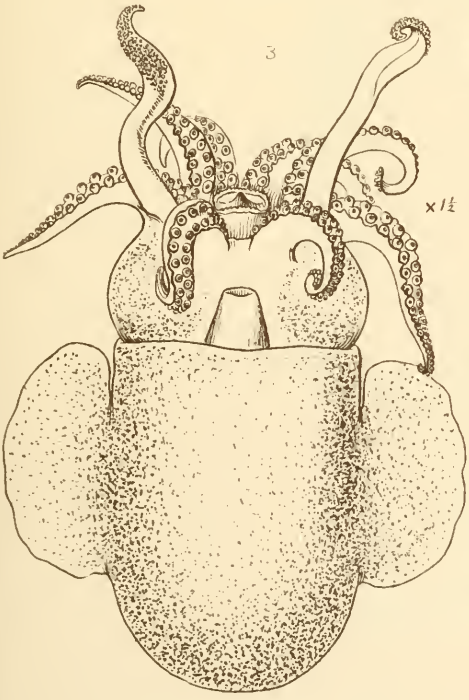
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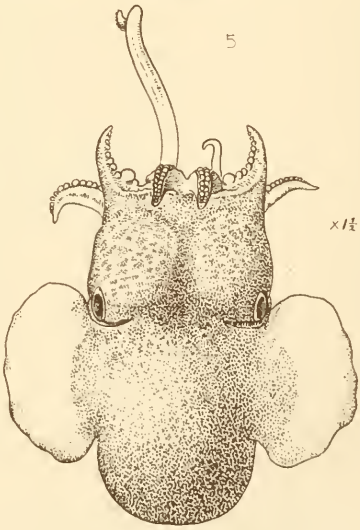
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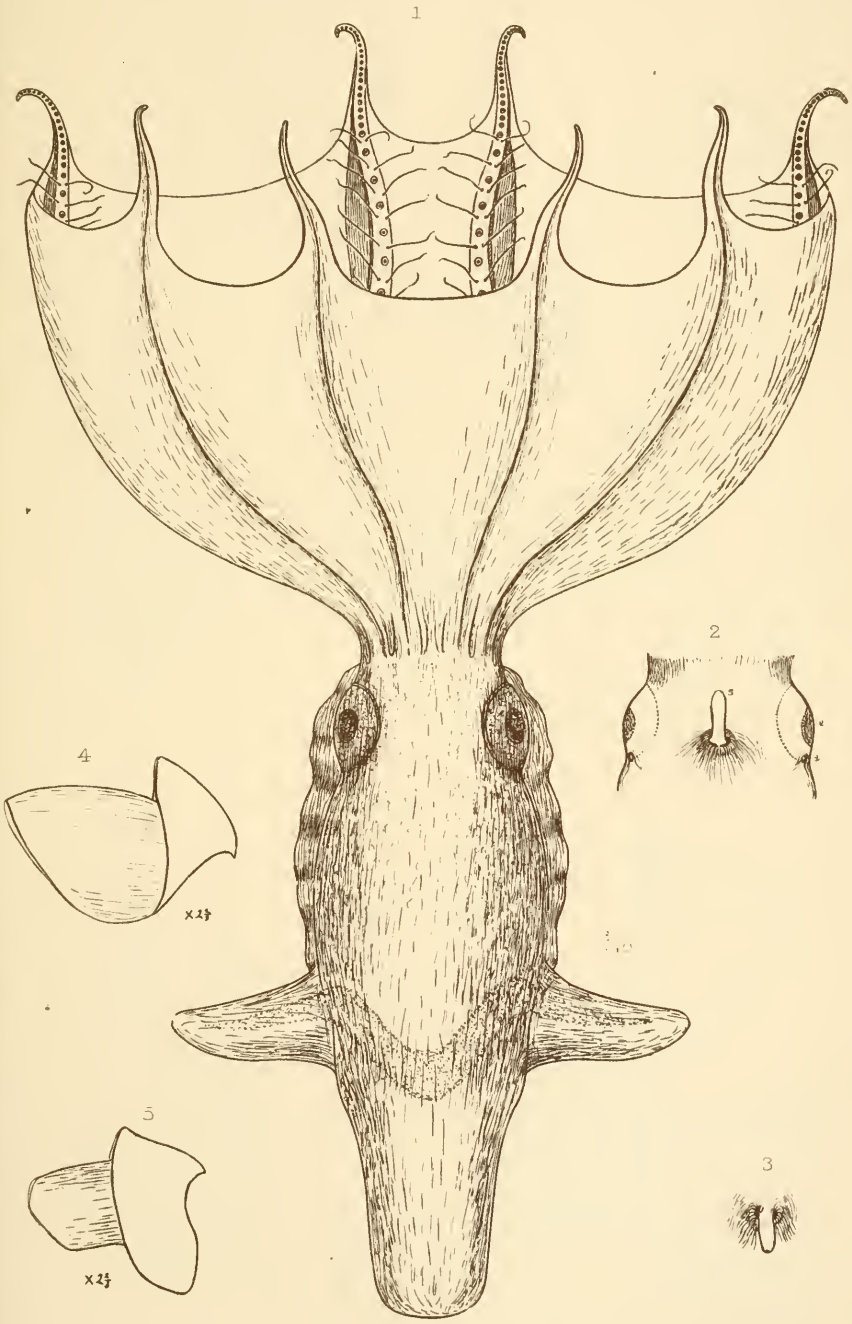

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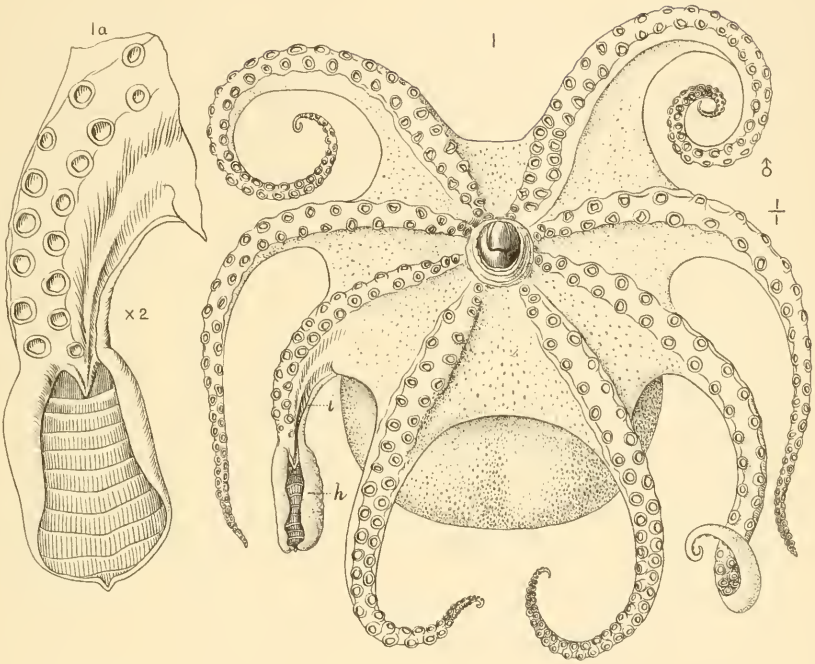
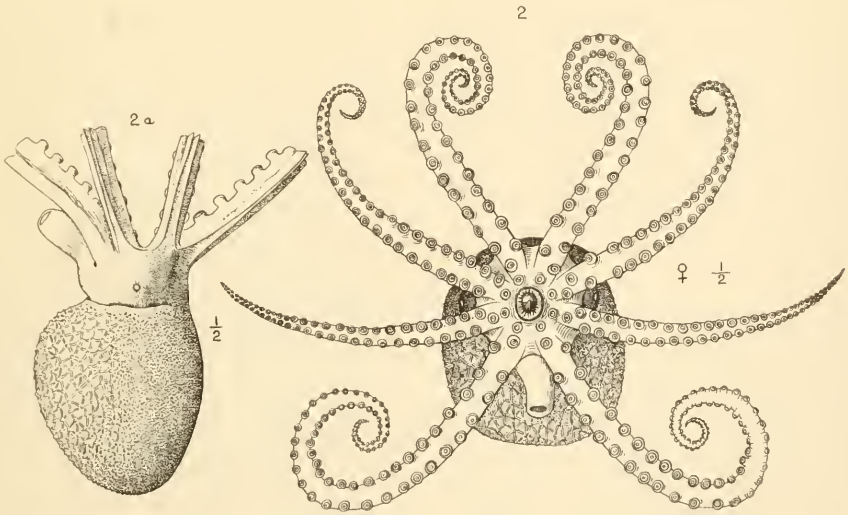
STAUROTEUTHIS SYRTENSIS VERRILL





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OCTOPUS BAIRDII V. AND PARASIRA CATENULATA. ST.

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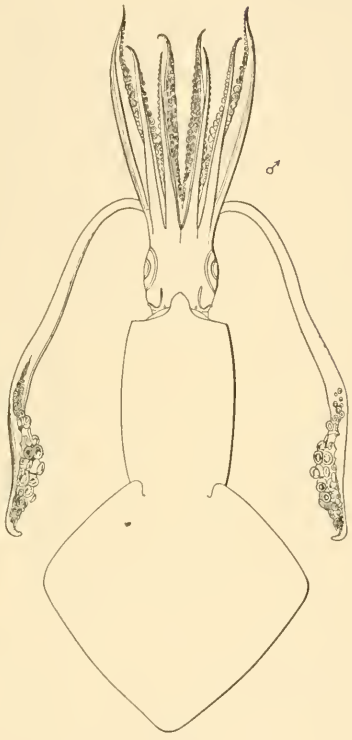

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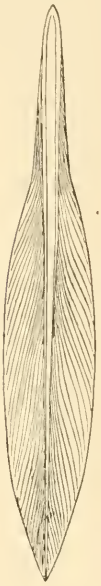

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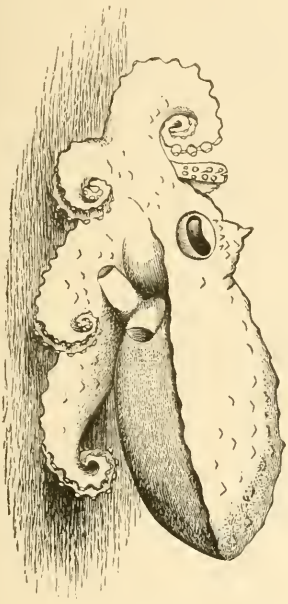

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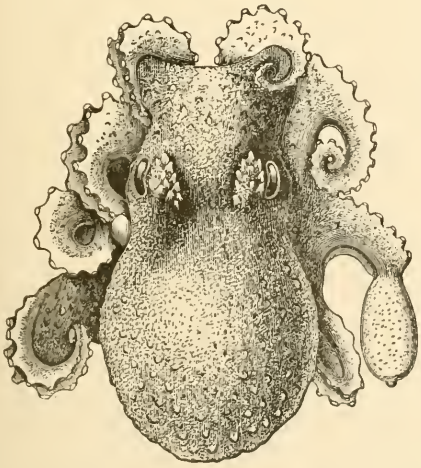

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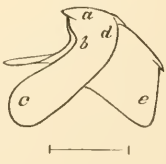
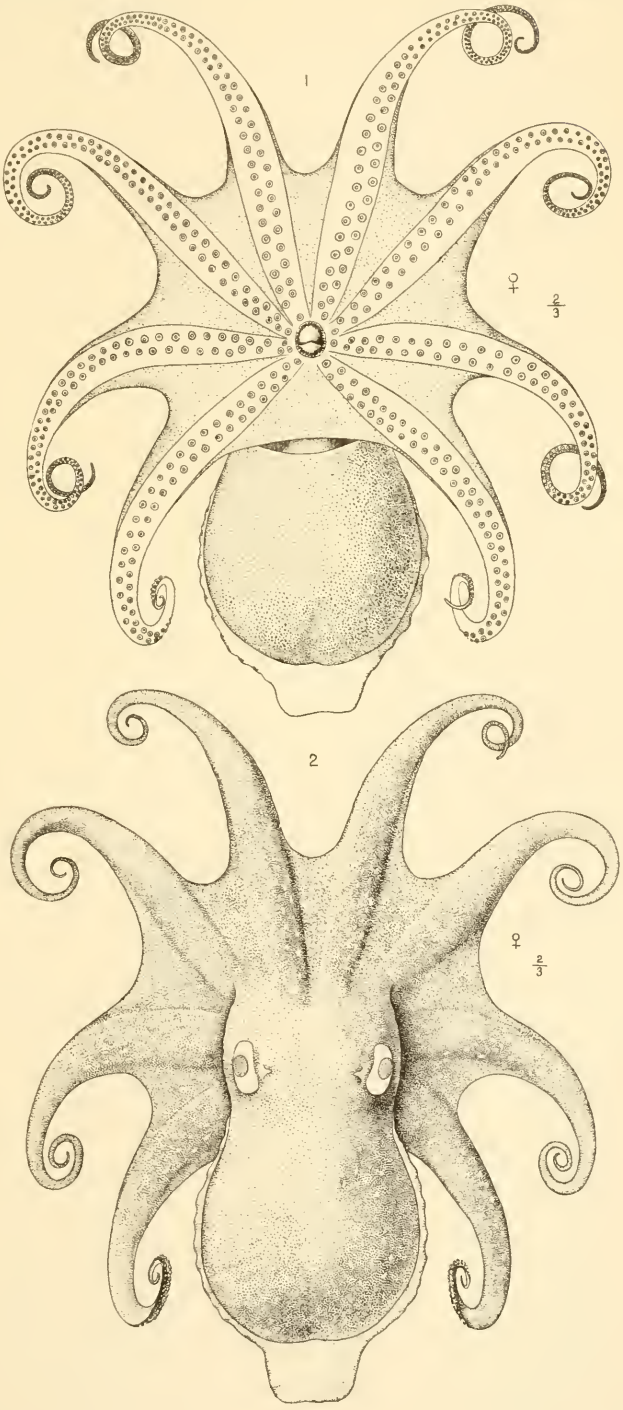


J. H. Emerton and A. E. Verrill, from nature.



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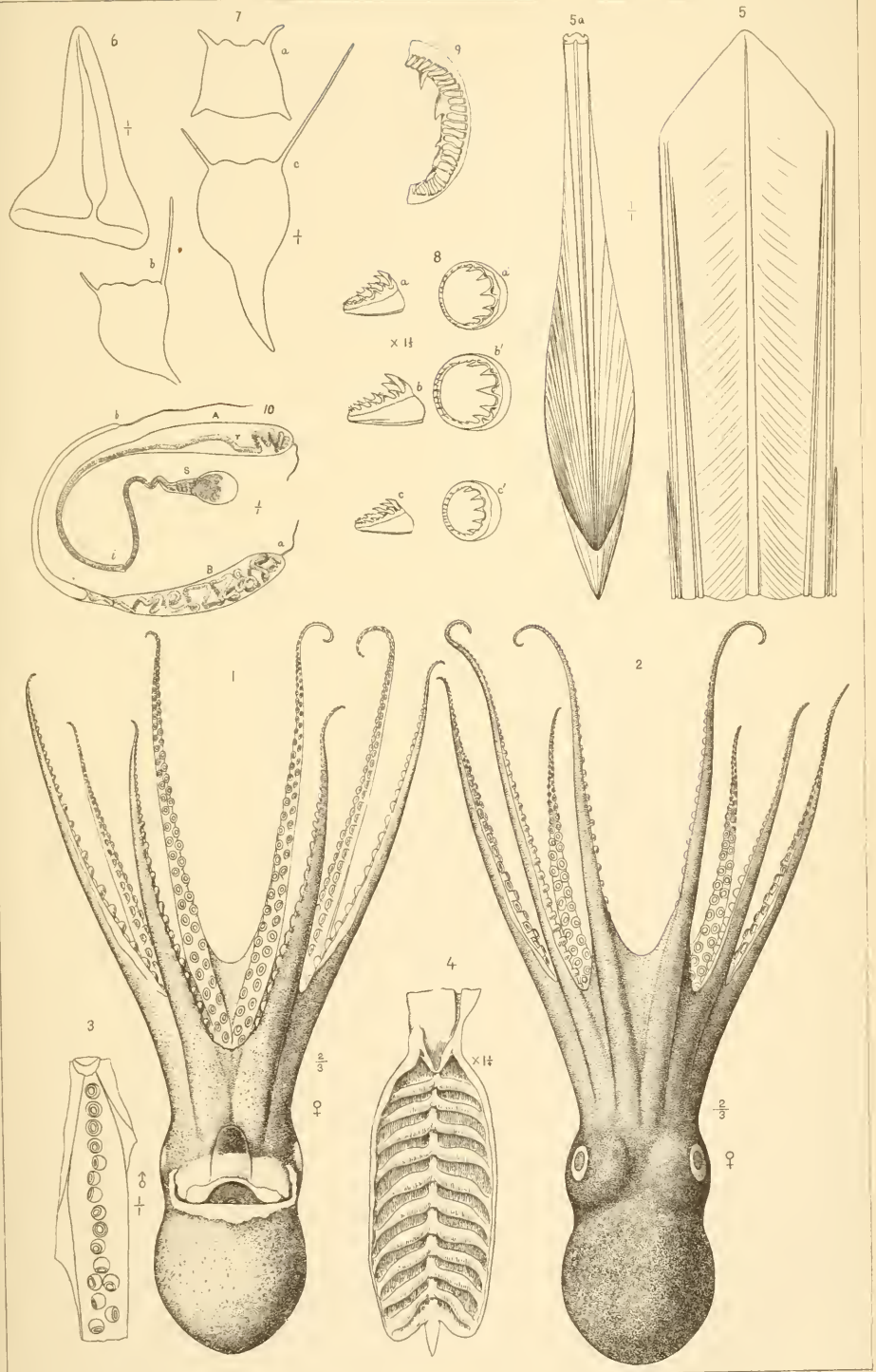
OCTOPUS LENTUS VERRILL



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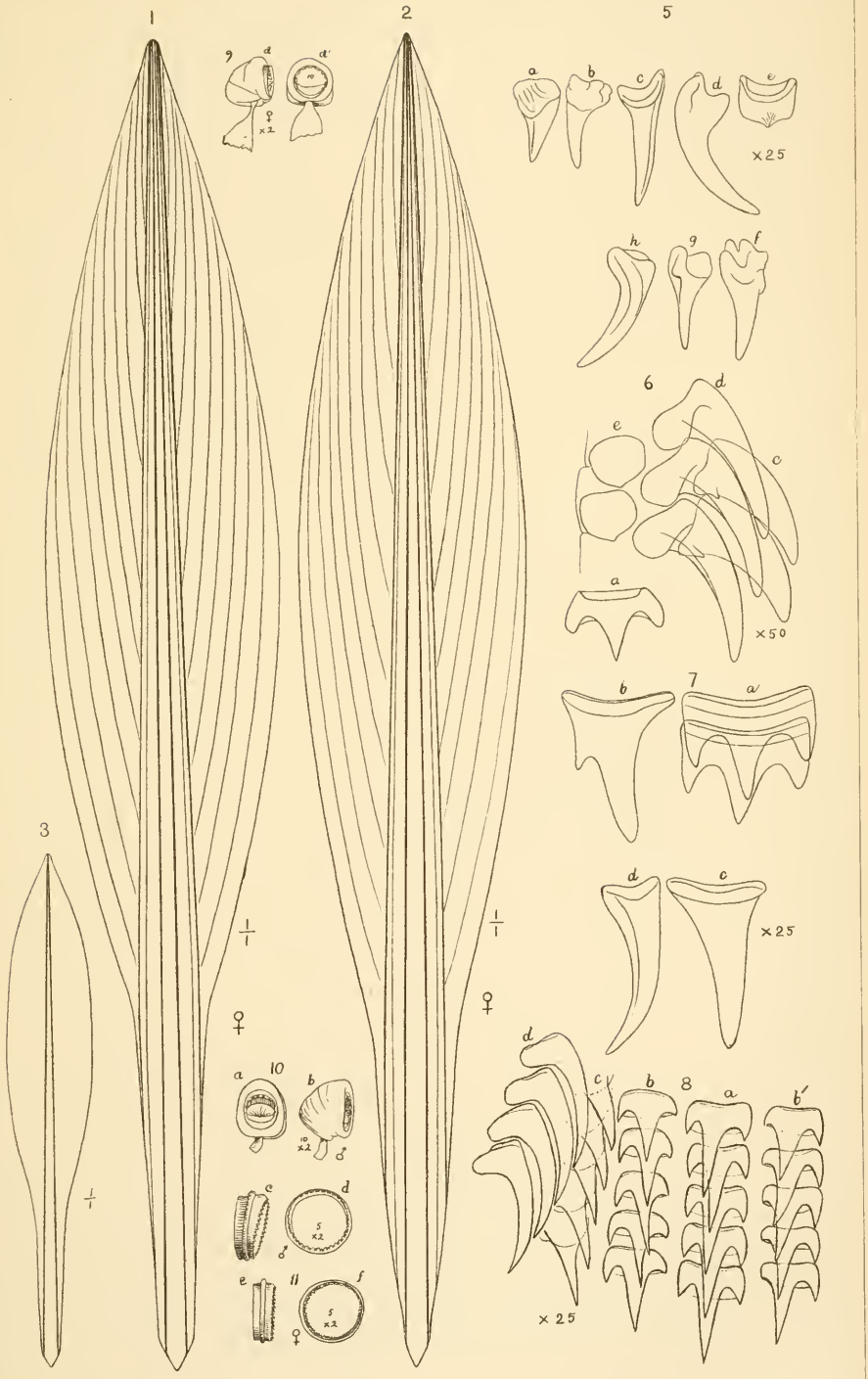
OCTOPUS PISCATORUM VERRILL etc



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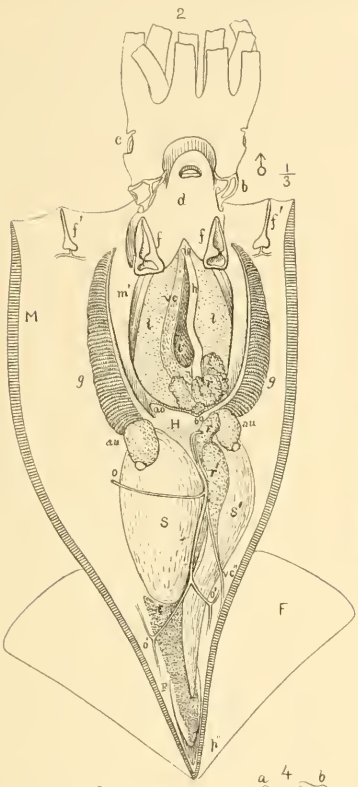

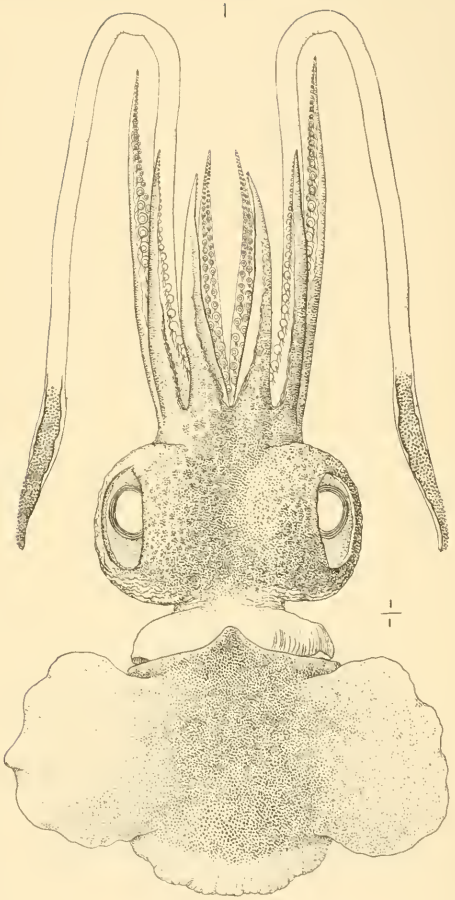

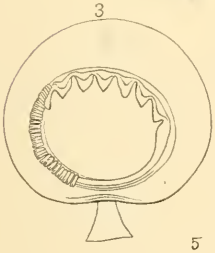

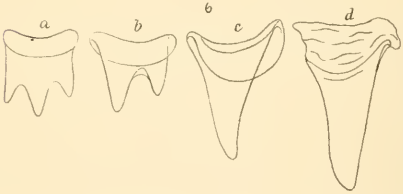

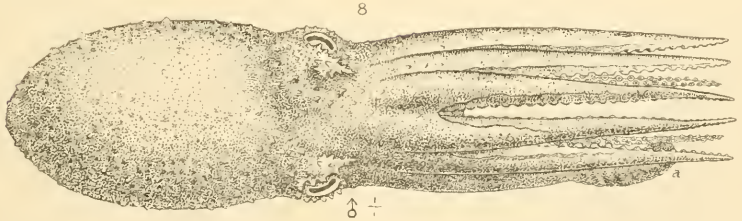

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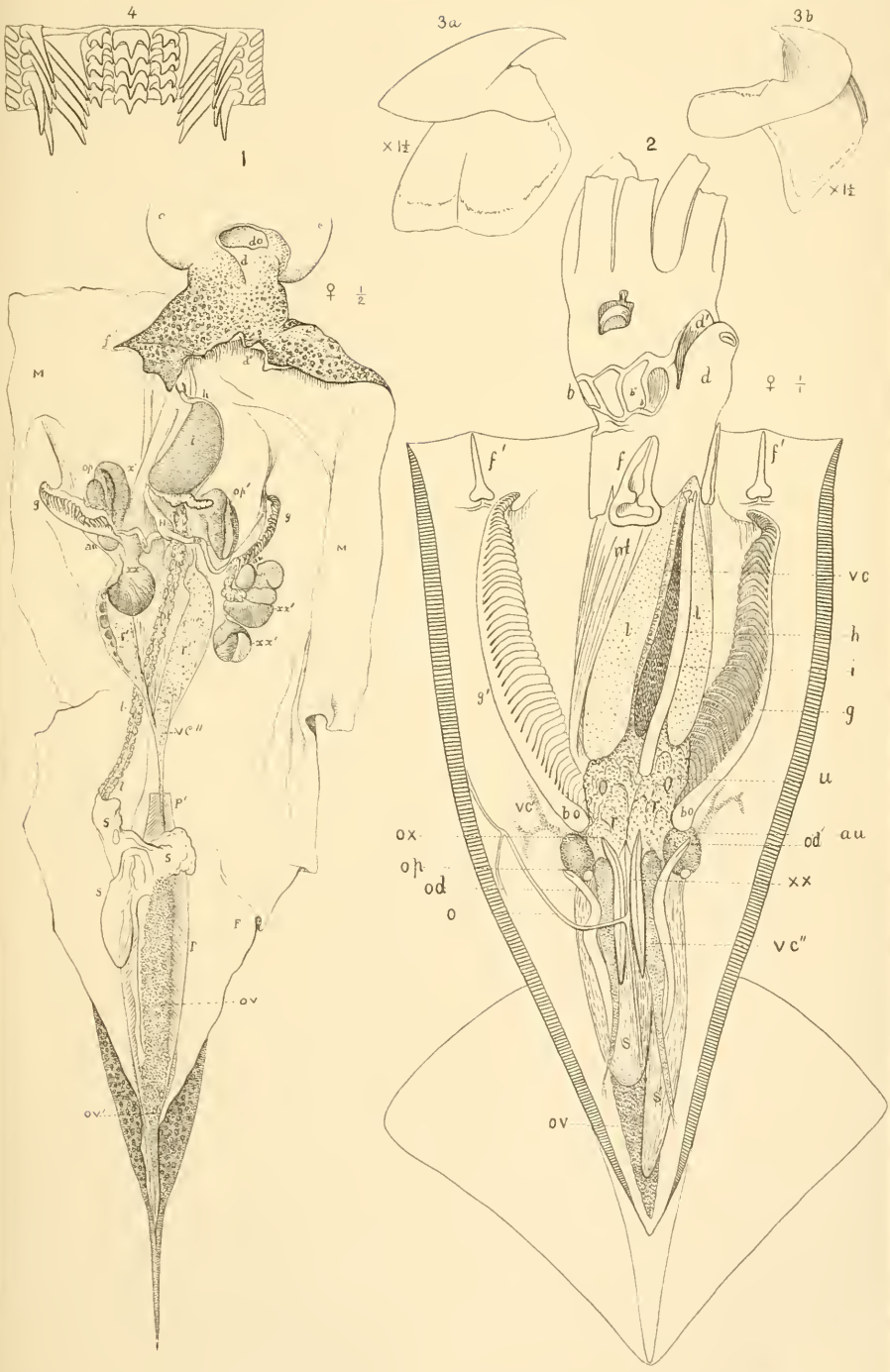
Photo-Lith. Rundarson & Co. New Haven Ct.

1 BOSSIA NEGAPTERA V, 2 OMMATTEPHES, 3-6 ARCHITEUTHIS,



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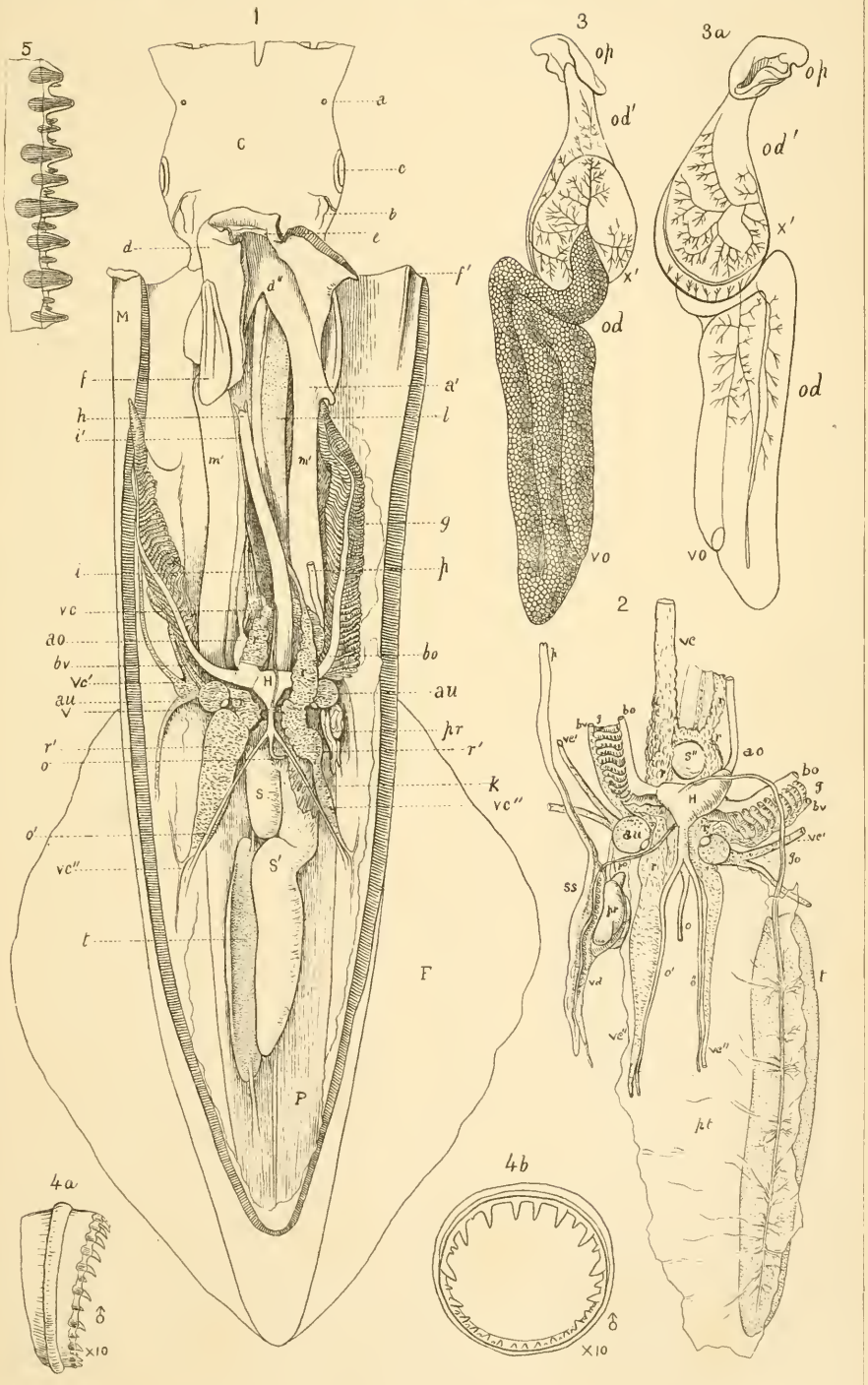
LOLIGO PEALEI LES. TAONIUS HYPERBOREUS ST.



A. E. Verrill & J. H. Emerton from nature

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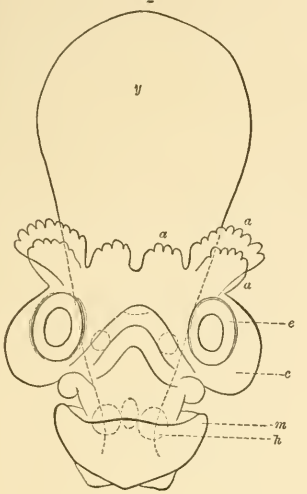

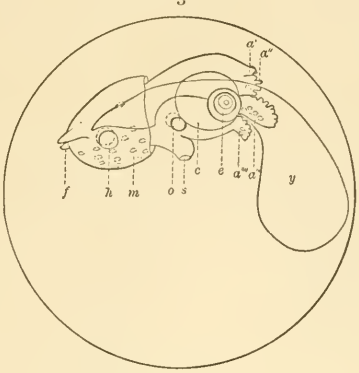

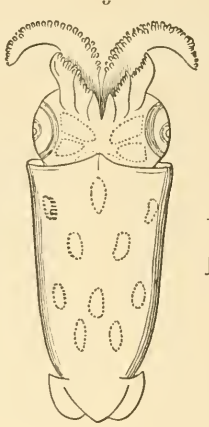

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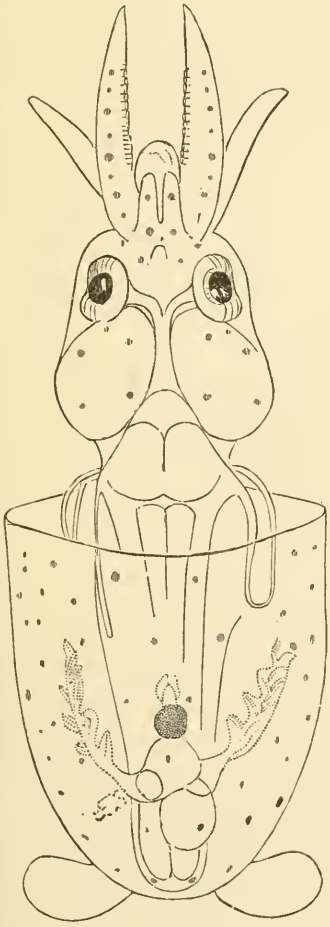

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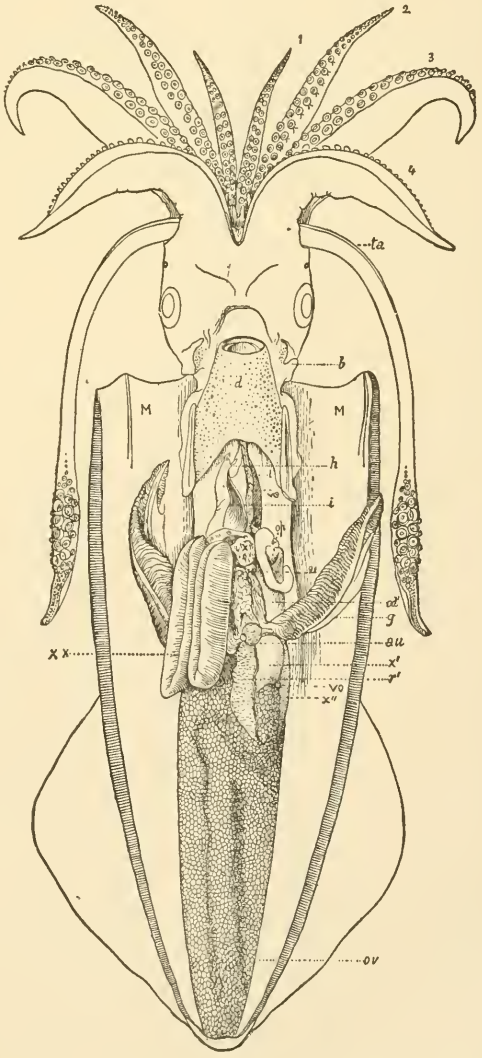

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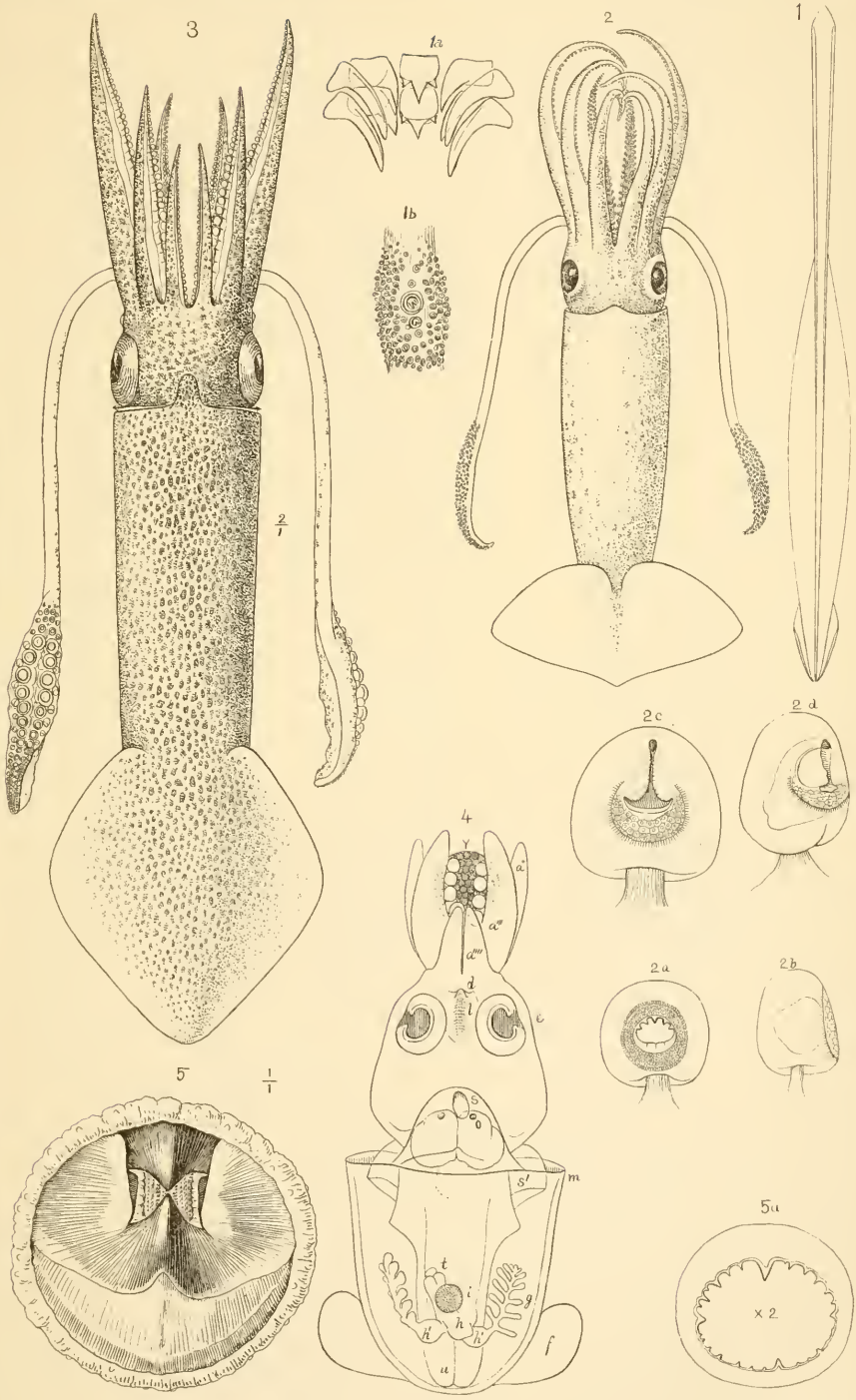

J. H. Emerton del

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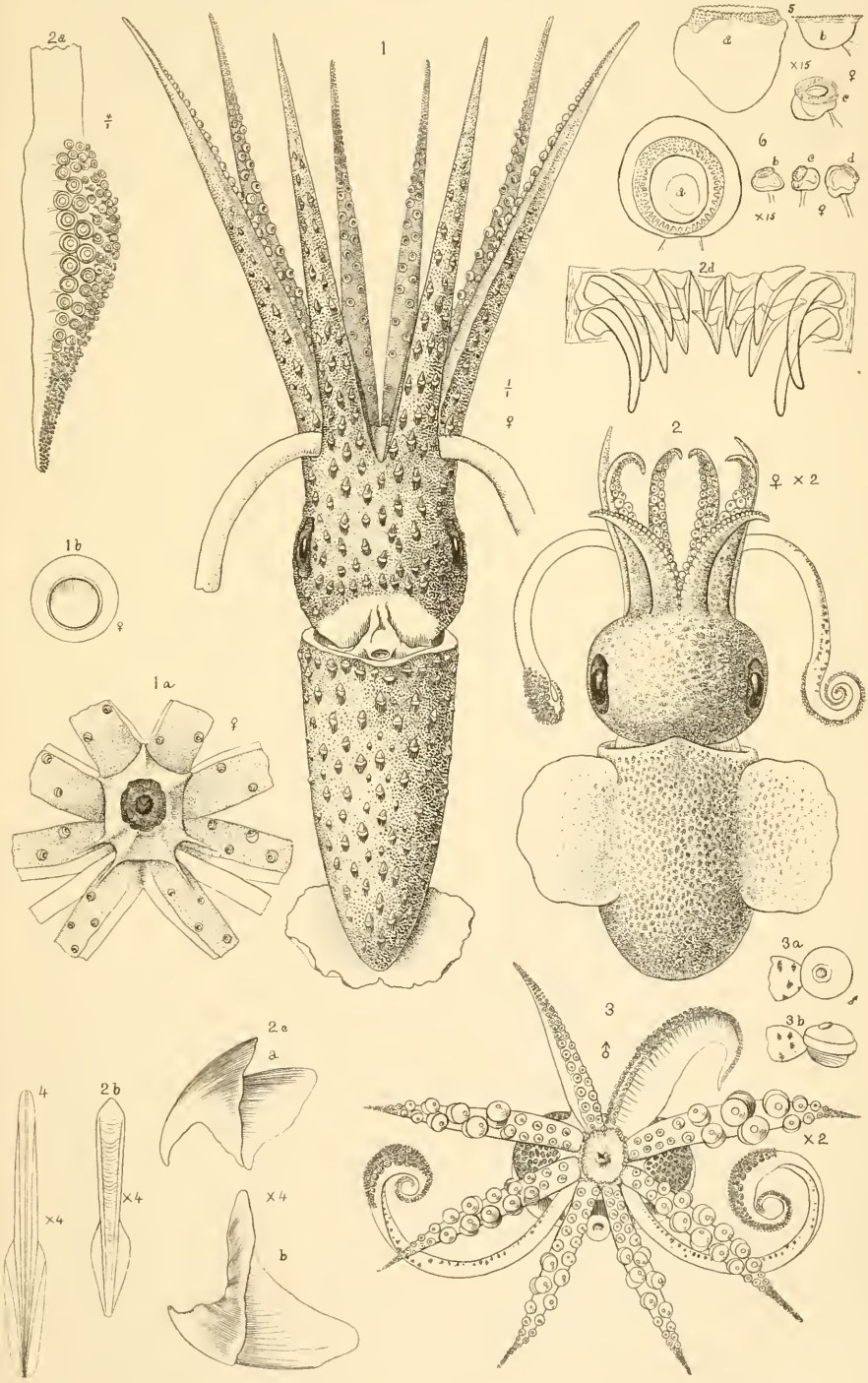
CONATUS FABRICII. LOLIGO PEALEI. STHENOTEUTHIS MEGAPTERA.



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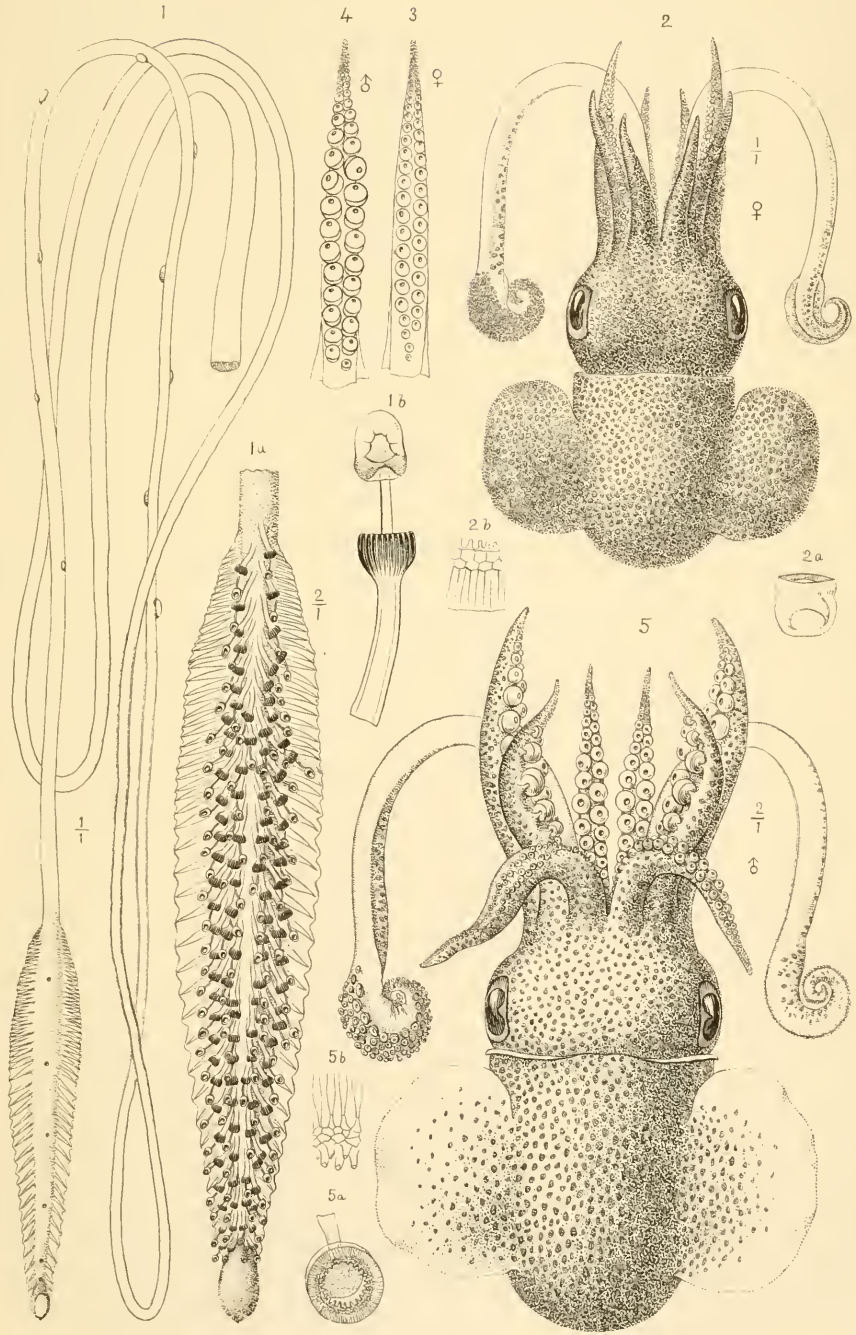
GALLITEUTHIS REVERSA HETEROTEUTHIS TENERA



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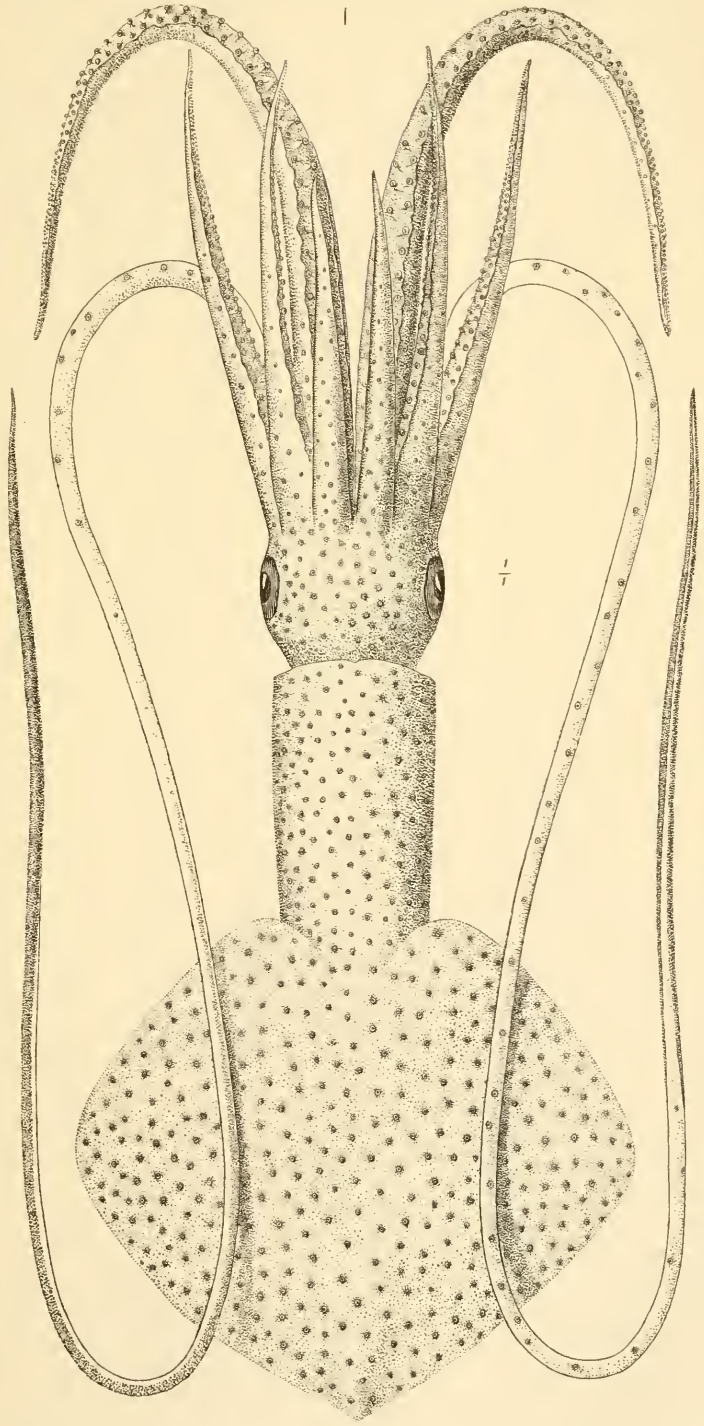
CHIROTEUTHIS BONPLANDII. ROSSIA SUBLEVIS. HETEROTEUTHIS TENERA, etc.



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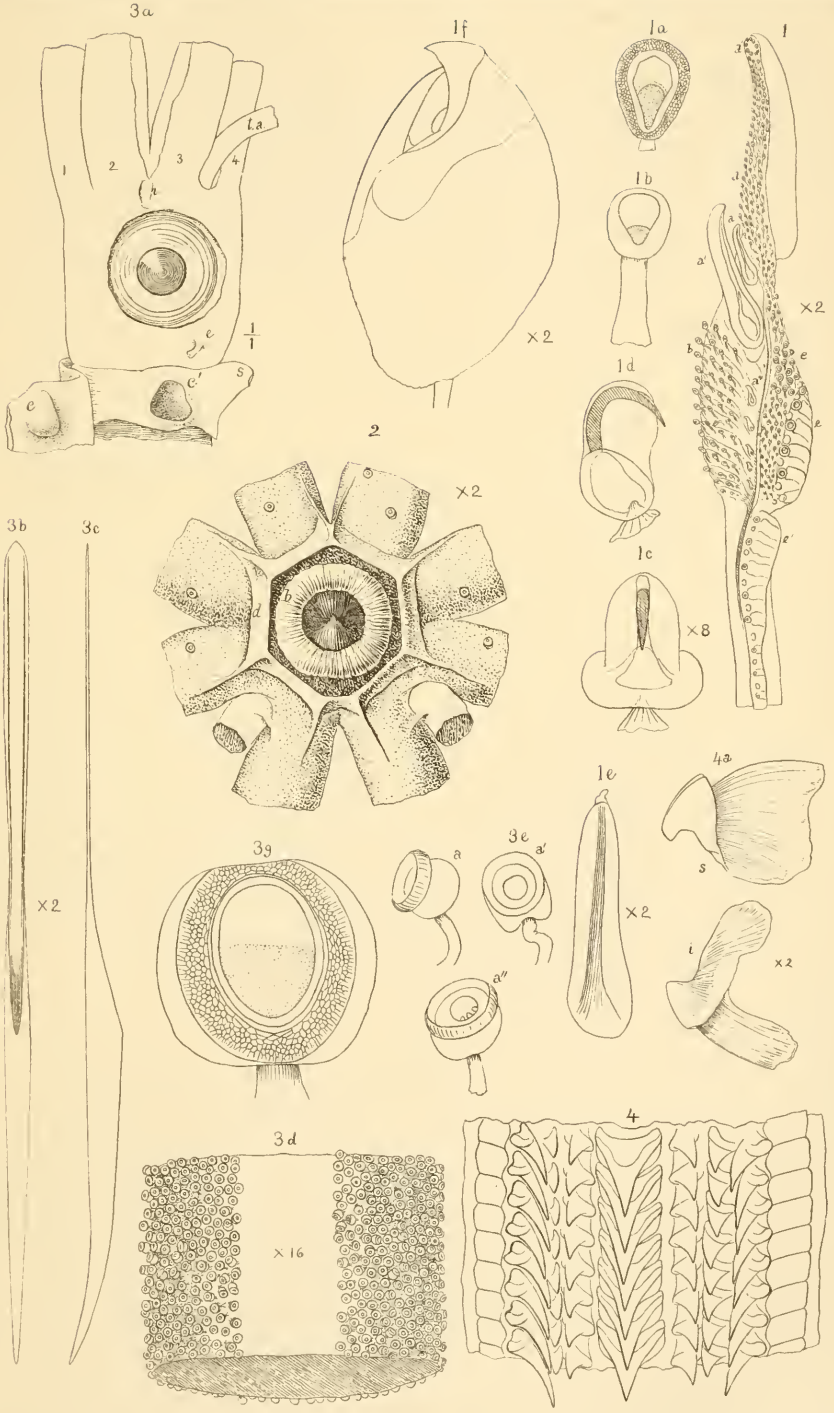

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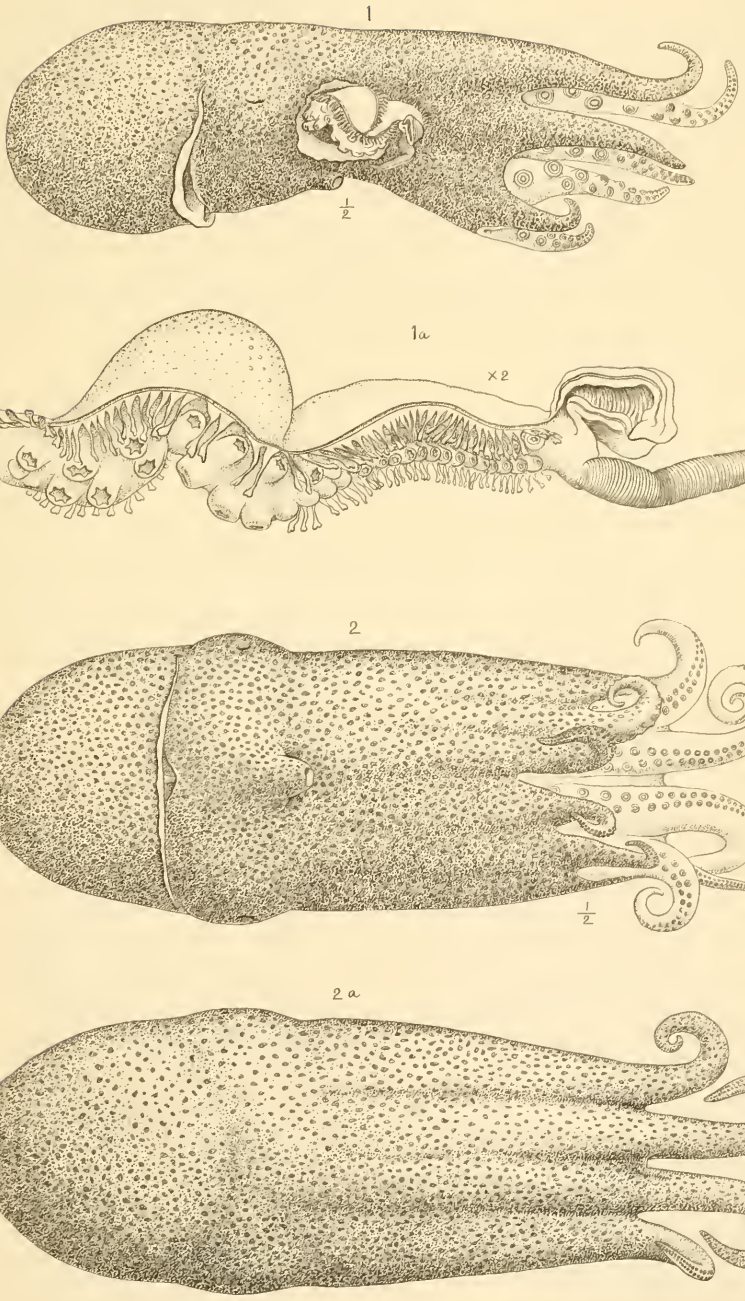

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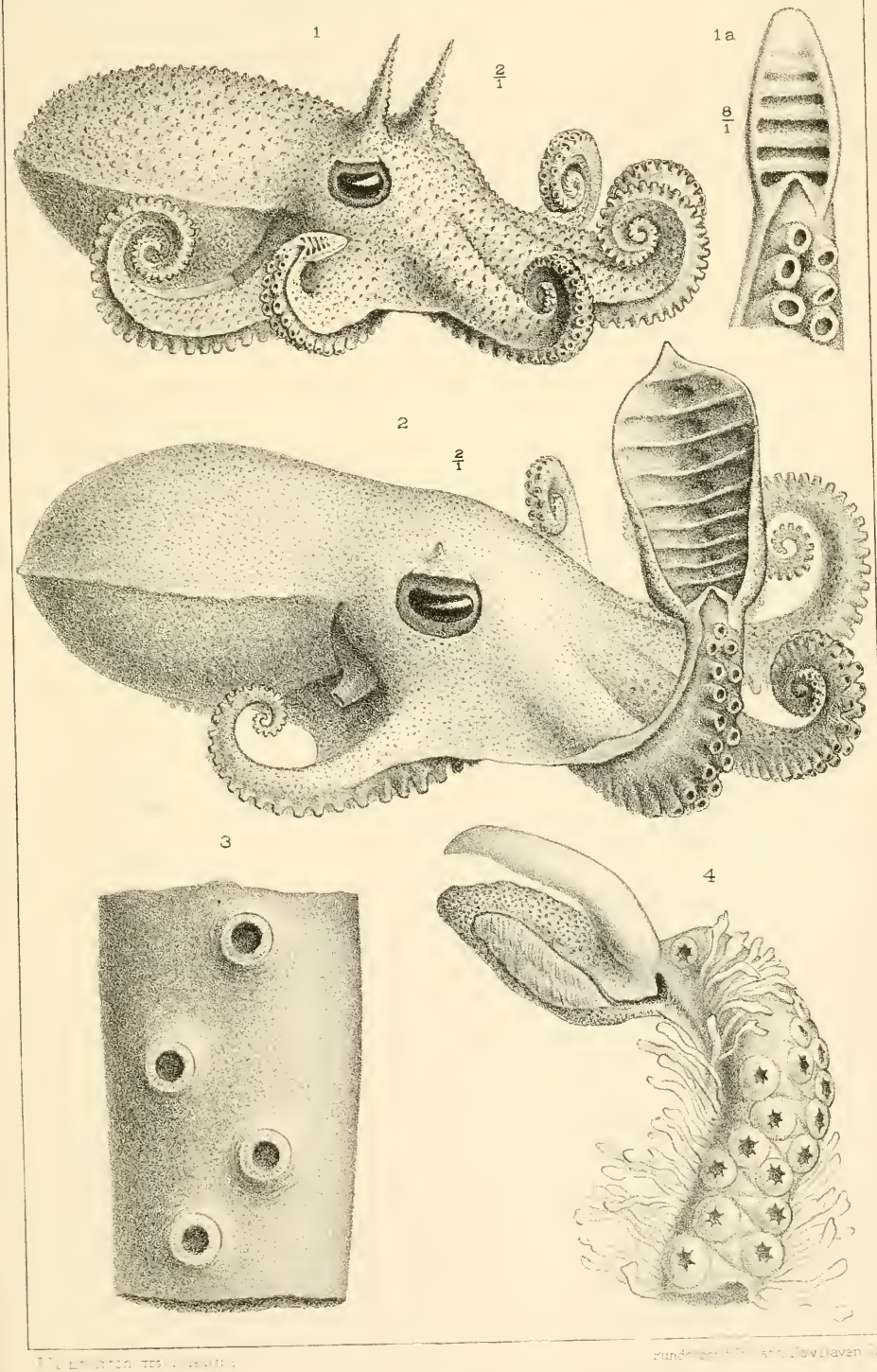
ALLOPOSUS MOLLIS, VERRILL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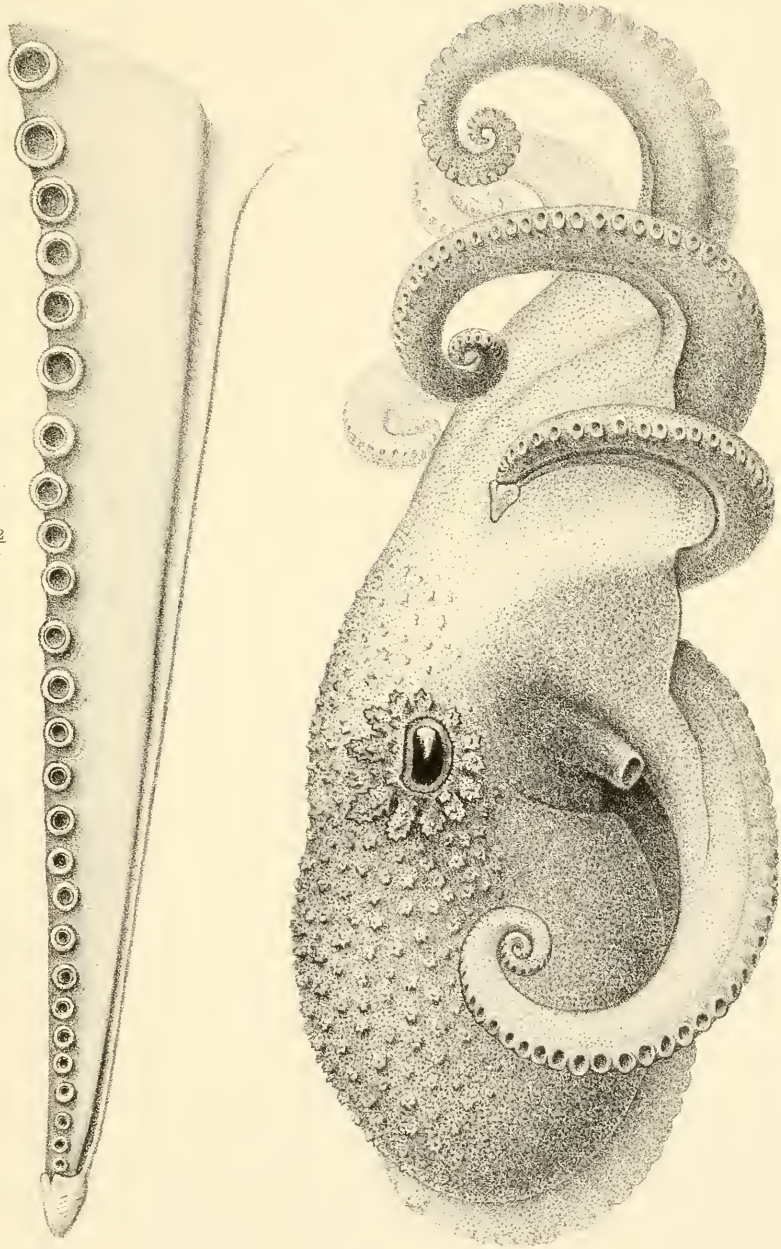

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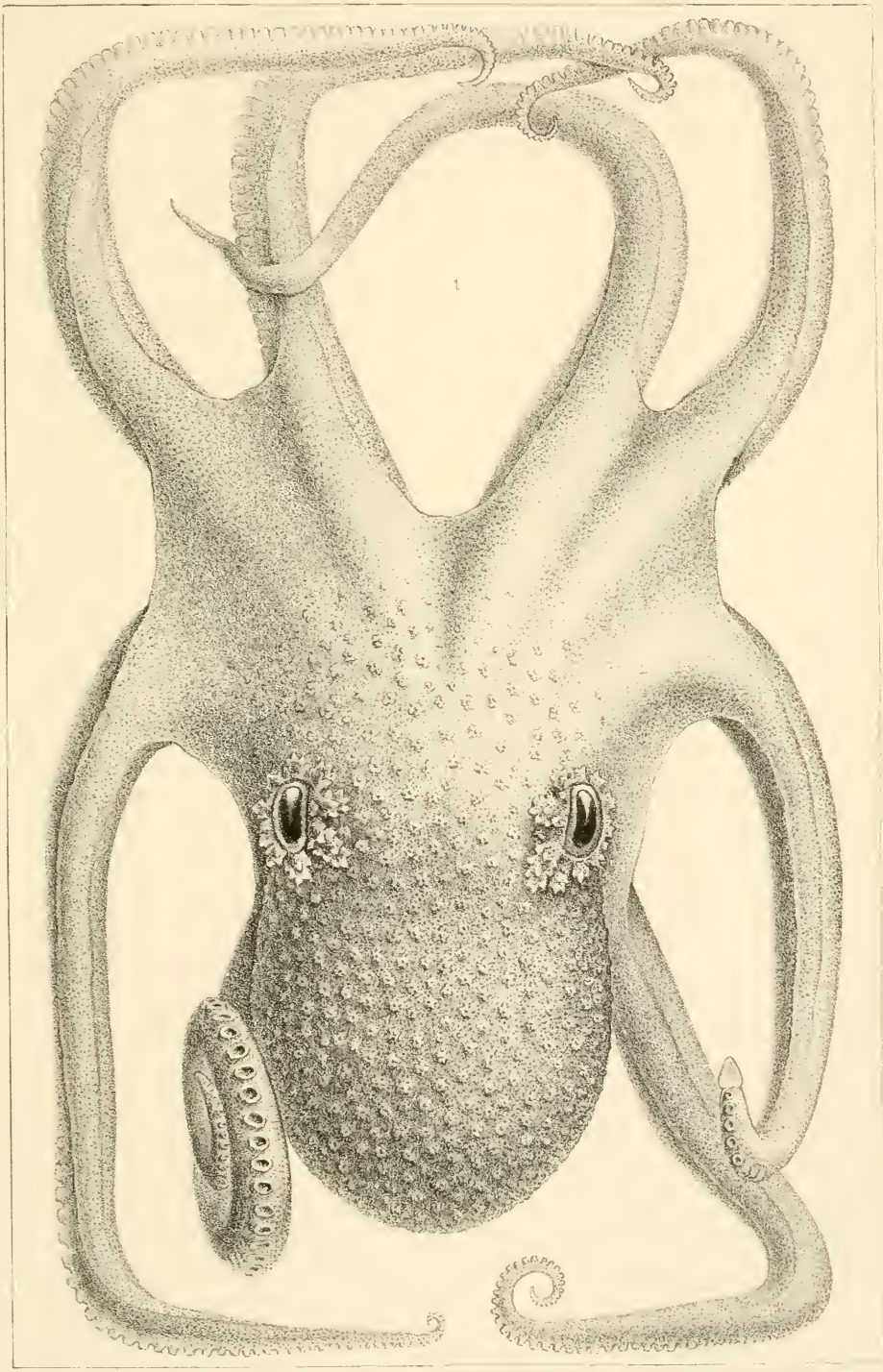
ELEDONE VERRUCOSA.



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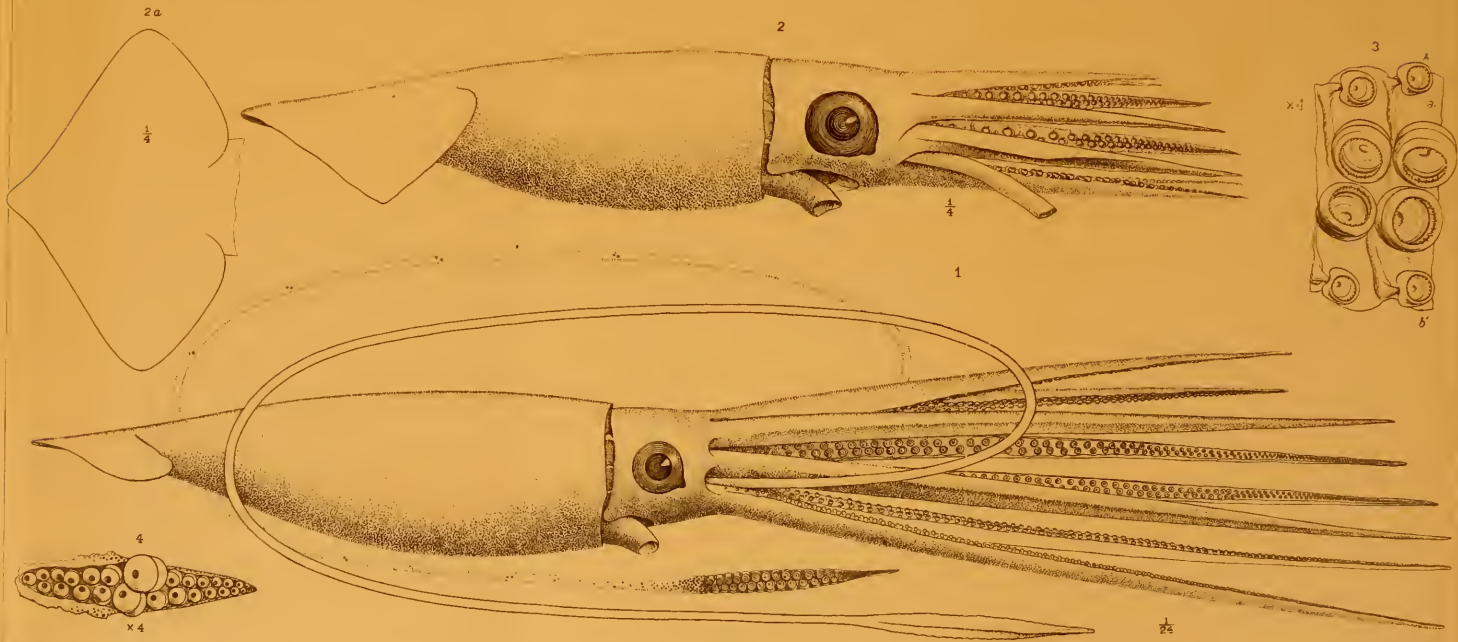
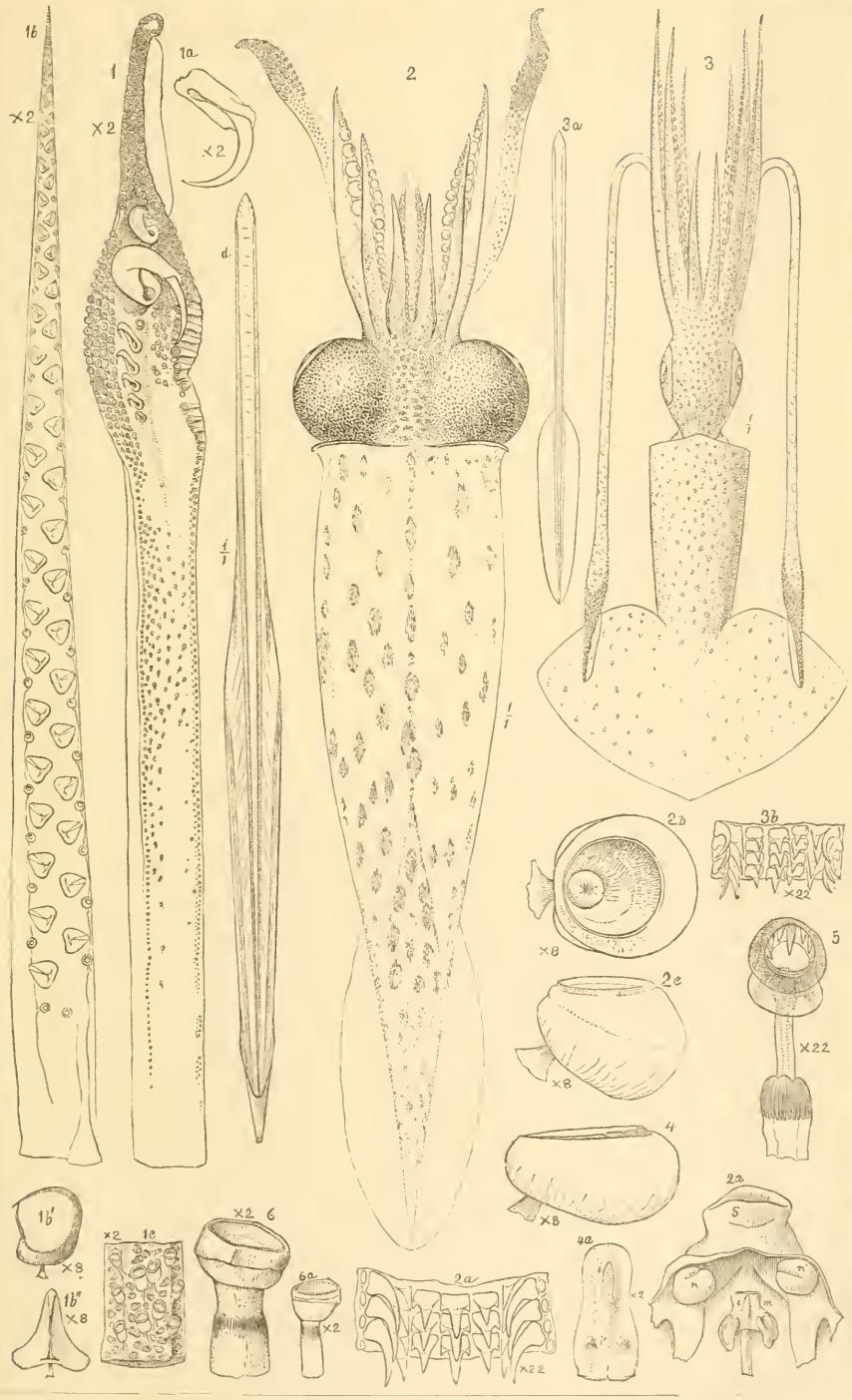


ARCHITEUTHIS, STHENOTEUTHIS, etc.



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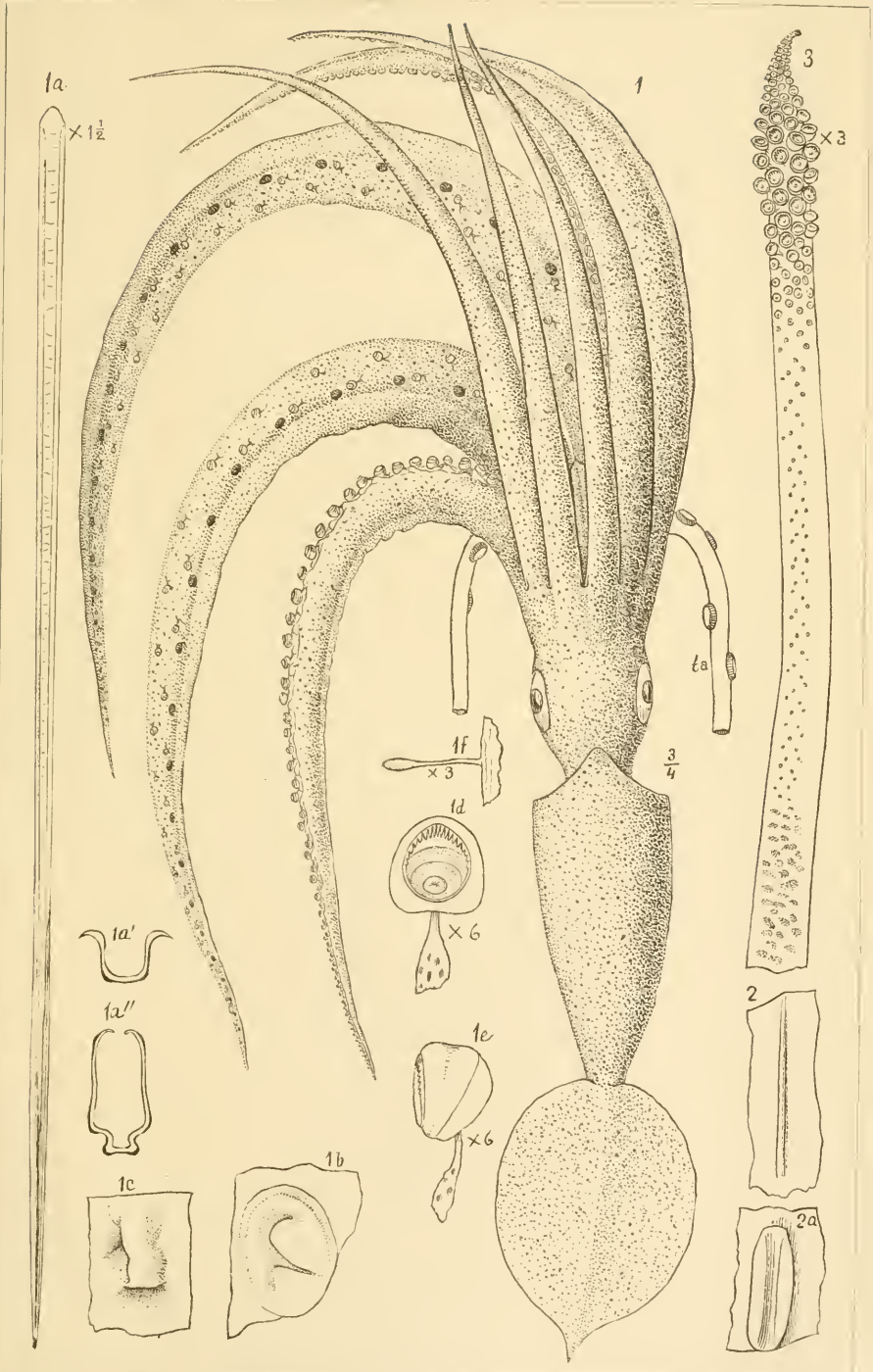

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